Municipal and County Engineering

DESIGN, CONSTRUCTION, OPERATION AND MAINTENANCE OF ALL PUBLIC WORKS

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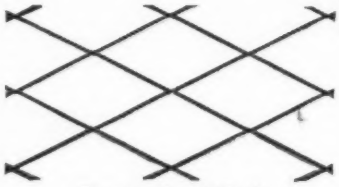
Reinforcing Steel Saves Expense on Concrete Roads



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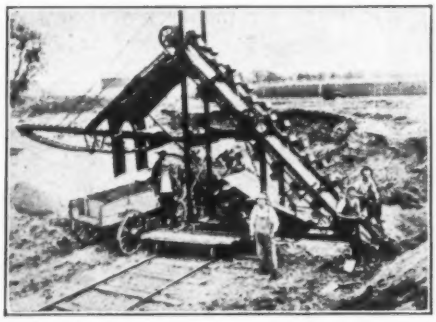

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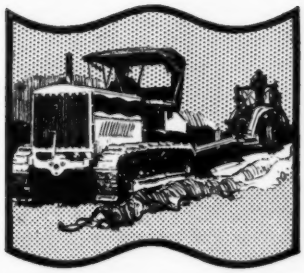

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MOTOR TRUCKS

Motor Trucks as Operated in Municipal and County Service and in Highway Transportation

PUMPING WATER SUPPLY OF CLINTONVILLE, WIS., DURING EMERGENCY WITH F W D FIRE TRUCK.

Motor Truck Operation and Accounting LXX

SHOULD ROAD CONTRACTORS BUY OR HIRE MOTOR TRUCKS?

Several expressions of opinion of men in the motor truck industry on whether it is better for road contractors to buy motor trucks or sublet their hauling work to motor hauling contractors, were published in the May issue. Some additional opinions are here expressed. H. C. Horine, of the International Motor Co., of New York City, writes:

"It is obvious, as in any other kind of work where the hauling to be done amounts to considerable volume, such that the trucks can be kept working a satisfactory number of days per week and weeks per year, that there can be no economy in contracting with others to operate trucks at a rate to cover the cost of operation plus a profit for the truckmen. If the road contractor can operate his own trucks as economically as the truckman owning his trucks he is simply saving the profit which he would otherwise have to pay the truckman.

"The advantages of the road contractor owning his own equipment, in addition to this fundamental one of cost of haulage, are many.

"For example: It is possible for the road contractor to employ a perfectly standardized fleet, standardized not only as to make of truck but as to capacity and special body and hoist equipment. This standardization tends to keep all of the trucks moving at approximately the same speed so that work may be laid out and scheduled accurately so that there is no congestion of trucks or delay at the various operations due to the trucks having different speeds. The trucks may all have the same size and speed and consequently loading and unloading of the material will be uniform. If, for instance, the trucks are being loaded by a steam shovel a standardized fleet will each take the same number of buckets of material; if they are dumping gravel, sand, rock, asphalt, etc., each load will be of the same quantity and so may be more easily spotted along the job. All trucks will be the same wheel gage and so may follow the same ruts on new ground. All may be of large capacity, which not only makes for a lower cost per unit of load handled, such as per yard or per ton, but means less total loading, maneuvering and unloading time; fewer vehicles to keep track of; and less interference with the work of the road construction gangs.

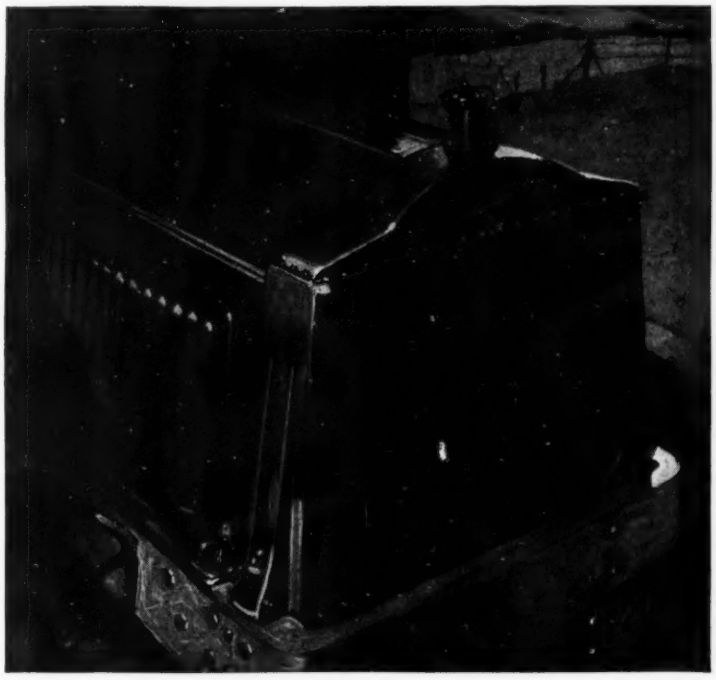
"It is sometimes of advantage for a contractor to own his own trucks when the volume of work to be done is not uniform, inasmuch as in the event of an extra amount of hauling being required overtime or extra shifts may be handled without difficulty and without exorbitant extra charges, or if it is necessary to withdraw one or more trucks temporarily or cut down the amount of work done by each, it is not necessary to pay for work not accomplished nor is there any difficulty about resuming the full schedule of work when it is again required. With hired trucks it is not possible to lay up a truck at will and have it instantly available upon demand.

"It is oftentimes impossible to secure trucks of uniform tonnage or speed when they are hired from truckmen and the rate per day to be paid therefore sometimes is not entirely equitable in each case. There is also some danger, where hauling is done on a tonnage basis, of operators overloading their trucks, which in the case of a new roadbed often does considerable damage and which would be eliminated were the proper distribution of weight to tire width adhered to. In the case where a number of trucks, say from eight upwards, are to be used on a job it is often not possible to hire the entire number required from one truckman and accordingly the cost of maintaining small fleets, particularly mixed fleets, is higher than when the entire fleet is of one type and maintained in one shop."

Mr. George E. Schumacher, secretary of the Available Truck Company, Chicago, writes:

"The average contract for road building we understand is let on a time basis. Regardless of whether this is a fact or not, it is only reasonable to expect that the contractor would make an effort to complete his work in as short a time as possible. We believe that better efficiency could be had by owning his own

PACKARD



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trucks which would give him absolute control of his equipment at all times.

"One of the largest problems facing road contractors is to keep the trucks in operation. Very often the construction is being done several miles from either a town or garage. An individual owner is paid on a tonnage basis and he makes a special effort to haul as many loads per day as possible. Very often when he is running low of oil or if his truck should need other attention, he sees nothing but the "dollar" for delivering his load. Very often this neglect results in serious trouble which places his truck out of commission for several hours or possibly days, in which event the contractor would be compelled to hire additional trucks.

Consider the possibility of a contractor operating ten of his own trucks on a road building job. One man would be sufficient to oversee the care of these trucks and compel the chauffeurs to oil and grease and care for their trucks at regular times. Sufficient supplies representing a very small investment would be kept on the job at all times to take care of this service.

"Our experience with dump trucks on road building work has convinced us that this is one of the hardest kinds of services and the most severe test that motor truck equipment can be put to.

"Some owners who are operating from one to three trucks for contractors inform us that the average life of the motor truck on such work is two years as a maximum. This is considering only high grade trucks. We believe that if these trucks were properly cared for and not driven at excessive speeds that at least two years could be added to their life.

"We have not referred to the profits which are derived by contract hauling. Unquestionably these people are making money. We believe that the contractor would add to his profits by owning and controlling his own equipment. We have been given to understand that some of the largest contractors in Chicago own their own trucks, but do not acknowledge this fact. No doubt they have found it a profitable investment or they would not continue to operate their own equipment."

TRANSPORTATION EQUALITY

By M. L. Pulcher, Vice-President and General Manager Federal Motor Truck Co., Detroit, Mich.

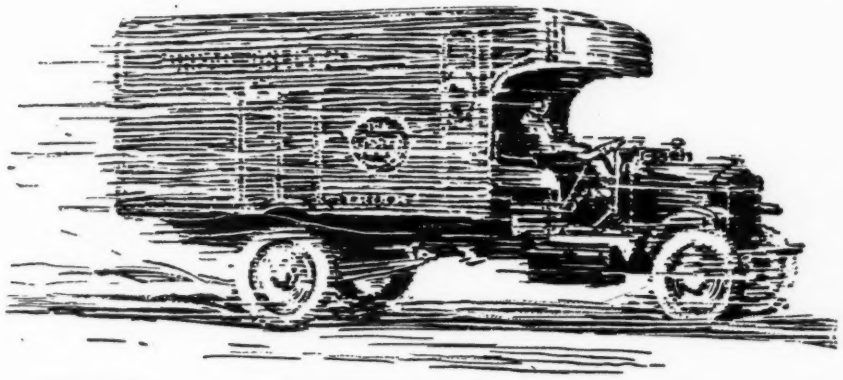
Many states are proposing legislation to limit the load that can be carried by a motor truck to such a degree that thousands of firms and men now owning heavy duty equipment will be forced out of business, and the capital invested in their trucks will be almost a total loss. Also, state and national taxation of motor trucks and passenger cars is being carried to an unreasonable point.

It seems that the old fable of killing the goose that laid the golden eggs has been forgotten, for motor trucks are one of the greatest aids to commerce that we have today. Motor trucks hauled 1,200,000 tons of freight in this country in 1920. This stupendous tonnage was almost one-half that carried by the railroads in the same twelve months, which amounted to 2,504,000,000 tons.

These figures do not represent a competitive tonnage, however, for most of the goods hauled by the trucks were also hauled by the railroads, and vice-versa. If the fast motor haulage had not fed the railroads, then the latter could not have transported this great volume. On the other hand, if the railroads had not borne the burden of the long haul, then the trucks could not have had the shipments to deliver at the other end.

But there are other ways in which the motor truck helps business and government besides quantity of goods hauled. The profits made in manufacturing them are taxed by the government. An additional excise tax is collected on the sale of each motor truck. The eventual owner also pays a state license tax usually based on horse power and weight. And in addition to all this, some states are now collecting a fixed sum for heavy duty trucks. In others, as before stated, they are ruling heavy duty trucks off the road —or taxing them off—which amounts to the same thing in the end.

There are five main means of transportation today—steam, electric, inland waterways, motor vehicle, and horses. Each one is particularly suited to certain kinds of transportation, and should be allowed to do that haulage for which it is fitted with the least hindrance. They all serve the public, which, in the end, is the government. There should be no discrimination against any one of these as opposed to the other. Each should grow and develop in proportion to its usefulness to the country. Certainly, motor truck owners, because they are making a fair living, should not bear a disproportionate part of the expense of government, nor should trucks be legislated off the roads or taxed where other



The Pacemaker

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forms of highway transportation are not.

If someone answers, "The automobile and truck spoil our good roads," just ponder over this fact—it is the automotive vehicle that has brought us the better highways, and has contributed largely to their maintenance. Two-thirds of the 9,000,000 automobile and 1,000,000 trucks are owned by people whose incomes are $4,000 or less per year. Ninety per cent of these car owners use their passenger cars more or less for business.

As far as traffic laws are concerned, motor truck manufacturers and motor truck operators are agreed that there should be laws governing the gross weight, width and length of vehicle and load, and that the first of these, the weight, should be on the tire-inch basis, but they feel that all states should have a uniform law. Much motor trucking today is interstate, and as they are regulated today operators never know whether they are breaking the laws until they are held for some infraction. Indeed, in many states the laws are so unreasonable that all truck owners are automatically infringing on the regulations.

The Federal Highway Council Uniform Road Law is eminently fair, we believe, to all roads and to all truck owners. This law limits gross weight to 28,000 lbs. and 800 lbs. per tire-inch, and speeds on pneumatic tires up to this limit of weight to 25 miles per hour. Lesser speeds are provided for different weights on solid tires. Fifteen states have already adopted this law, which is endorsed by many highway officials and associations. Legislation that limits weight and speed of motor trucks should be the same the country over, the same as that governing rates on common carriers. These laws, properly enforced, would then govern truck operation properly, prevent undue injuries to the road, and be fair to all concerned.

That our present national government realizes these things, and will eventually bring about an equality of burden on the various forms of transportation is our firm belief, based somewhat on President Harding's own statement that, "The motor vehicle has become an indispensable instrument in our political, social and industrial life, and highways are not only feeders to the railroads and afford relief from their local burdens, but they are actually lines of motor traffic in interstate commerce."

This view is shared by many men high in government and state offices, and will, no doubt, be an influence to discourage discriminatory legislation such as is being now proposed in many states, as well as to influence a sane and less discriminating taxation program.

It is certain that the automobile and truck are vehicles of usefulness. They are common conveyances, necessary to the business man, professional man and the farmer. Such an additional tax on them as was recently proposed by Secretary of the Treasury Mellon would be as senseless as one levied on the farmer's horse and wagon or upon every boat plying our rivers and lakes.

MOVING BY MOTOR TRUCK FROM CHICAGO TO INDIANAPOLIS—"A PERSONAL NARRATIVE"

Several full issues of this motor truck section in recent years have been devoted to the Intercity and Interstate Haulage of Freight in Motor Trucks Over the Highways, and in nearly every issue of this section some facts and figures have been published on this subject. We have consistently advocated the use of trucks for short-haul freighting, so when the editor had occasion, recently, to move his housefurnishings from Chicago to Indianapolis he was pleased to take his own prescription and shipped the goods by truck. In order to record some facts and impressions with reference to this personal experience in motor transportation, for the use of others, the editor is, for the first time, breaking his self-imposed rule never to mention himself or any of his affairs in the columns of this magazine, which is made by and for its readers. Perhaps this one lapse in the observance of the editorial proprieties will be pardoned by readers because of the specific information given. Previous articles have been written from the viewpoint of the motor industry while this is from the viewpoint of the man who paid the bill.

While sentiment favored the truck, the choice was made strictly on a business basis. The complete cost of moving the furniture in seven rooms from an apartment on the third floor in Chicago to one on the first floor in Indianapolis was $195. This figure covered the round-trip of the truck, which ran empty one way. It also included war tax and insurance for $2,000 against fire, theft, collision, upset or flood. The distance between the cities is an even 200 miles, by the route traversed.

KISSEL

Fleet of 10 Special Kissel Road-builders' Trucks– capacity 3 batches of one yard each.

Kissel Road-Builders' Service Includes—

1—Properly designed truck to carry 3 batches of 1 yard each to the mixer.

2—Kissel designed measuring boxes dump correct amounts of sand and gravel into the truck almost instantly.

3—Turn-table that turns loaded truck ahead of mixer in a few seconds.

4—Proper supervision.

The above service made possible delivering a load of 3 batches to the mixer every 5 to 6 minutes, using 10 Special Kissel Road-Builder Trucks on a 6 mile haul or 12 miles round trip.

For further data and photographs address,

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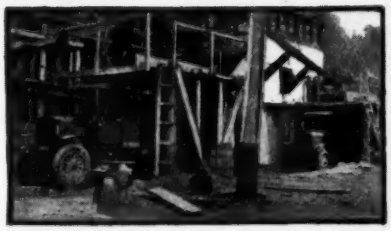
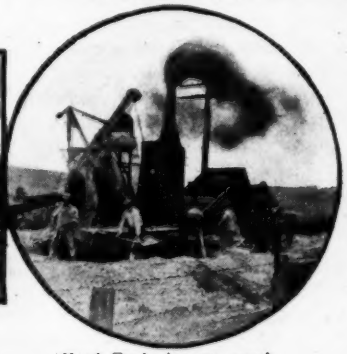


Sand and gravel bins with measuring boxes under which trucks drive for loading in less than 15 seconds.

Special Turn-table requiring one man to turn truck completely around in a few seconds.

Kissel-designed skip end.



Kissel Truck dumping second batch into skip of mixer.

About 40 miles of this distance is over paved city streets or concrete highways and the balance is over waterbound macadam and gravel highways which are in good condition. The truck left Chicago at 4:30 one afternoon and reached its destination in Indianapolis at 5 o'clock the next afternoon. Thus but 24½ hours were required for the trip and the movingmen took 3 hours off during the night to catch a bit of sleep.

The truck was of 5 tons rated capacity with van body and long tailgate.

It was not necessary to crate the furniture in moving by truck, and it naturally follows from this that uncrating was also unnecessary. Books were boxed for convenience in handling and dishes and glassware, of course, were packed, but with these two exceptions crating, boxing and packing were dispensed with entirely, even in the case of "pictures on the wall." The movers simply carried the furniture out of one apartment, loaded it onto the truck, swathed it in retired bed quilts, and later unloaded it and carried it directly into the other apartment and their work was done. Not a dish was broken and the few minor scratches sustained by the furniture were no more than is commonly experienced in any move, however short.

The balance of the story pertains to what might have been had we moved by rail. In that case there would have been a charge of at least $25 for cartage in each city. Crating for rail shipment, and to withstand the onslaught of the railway freight handlers, would have cost at least $125 from estimates submitted. Freight would have been $80. Thus the cost of rail shipment would have been at least $255 or $60 more than by truck. Nothing is included in this figure for uncrating, which probably would have been done by the nominal head of the house without pay. It probably would have taken a full week to ship by rail, promises to the contrary notwithstanding, judging by recent experience in shipping office furniture between the same cities.

The avoidance of grief in using the truck was considerable, for it was necessary merely to engage the intercity mover, whereas in moving by rail it would have been necessary to hire two movers, one in each city, and to negotiate with the railroad operatives for the use of one of their numerous but elusive freight cars. All the worry incident to awaiting the receipt of the car for use and its later arrival at its destination was eliminated by the simple device of engaging the truck, which came when it was called and went where it was told without delay.

But one point remains to be mentioned and that is one which will be appreciated by anyone who has had occasion to move. The crating for rail shipment would have required the services of at least three expert craters for three full days and the muss and racket they would have made is more easily imagined than experienced. Thus this crowning offense against domestic tranquility was avoided by the wonderful ease, directness and flexibility of motor transportation. We are much obliged to the motor truck and to the hard, smooth highway.

MOTOR TRUCK NEWS NOTES

Using Truck to Pump City Water Supply

One of the most novel uses of a truck yet reported is that of pumping a city's water supply.

The title-page illustration shows an FWD fire truck at Clintonville, Wisconsin, pumping water for that city's supply into a tower, shown in the distance, which is 164 ft. above the pumping station and approximately one mile away from it.

During a recent electrical storm the motors used at the pumping station in that city were burned out and, in the emergency, the fire truck was called upon and filled the bill in a very efficient manner. The truck, equipped with a 500 gal. pumper, was located near the city's well and the intake nozzle lowered into the water. The water was pumped through two lines of hose which were connected to the pipe lines inside of the pumping station.

Is Your Motor Truck Ready for Summer?

The sweltering days of summer will soon be with us and service stations will again be filled with heat-afflicted motor trucks. Will your truck be in the steaming-radiator line? Or is it prepared to give uninterrupted service during the summer months?

Overheating and other common hot weather troubles are usually due to lack of forethought and to mistakes that can be easily avoided. The main points which require attention are briefly outlined below by A. F. Masury, chief engineer of the International Motor Company, manufacturers of Mack trucks.

1. Do you understand the truck's cool-

You cannot get a truck that is better suited to your business than a Federal

There is a capacity built to fit your needs—a body made to meet your requirements

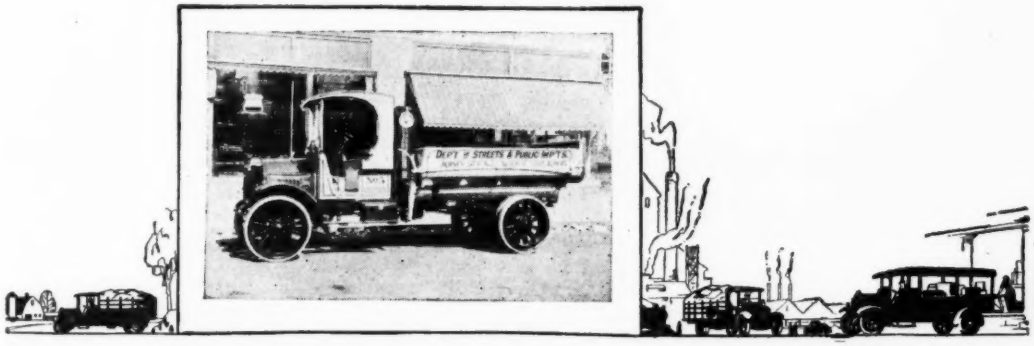
Federal engineers know the needs of business—and build Federal trucks to efficiently and economically fit them

Another **FEDERAL**

One to Seven Ton Capacities

Municipal officials are conservative purchasers. They buy only the best—tested and proved through the years. Their preference for Federal is due to its known value—its sterling record of performance during the 11 years of its manufacture. This is one of nine Federals in the various city departments of Jersey City, N. J.

FEDERAL MOTOR TRUCK CO.
35 FEDERAL AVE. DETROIS, MICH.



ing system thoroughly? If not, now is the time to go over it carefully and find out all there is to know about it. See that the flow of water is not impeded by any sort of obstruction and that the overflow pipe is not bent below the level of the base of the radiator filler. Be sure that the overflow pipe is not clogged or flattened.

2. Is the radiator clean? The front of the radiator should be free from dirt, license plates and signs. Also, the back of the radiator should be unobstructed so that nothing will impede the circulation of the air.

3. Are the hose connections watertight and is the hose in good condition? Be sure that the rubber has not been affected during the winter by an antifreeze solution. Only the best quality rubber hose should be used, as the inside tubing of cheap hose is easily worn away and the rubber particles carried along with the water clog up the radiator.

4. Does the fan turn freely and is the belt tension right? The fan should be clean and its bearings should be well greased. A good test is to turn the fan by hand with the engine shut off. If it is possible to slip the belt easily, but not possible to spin the fan, the tension is right.

5. Is the carburetor choke in proper repair so that it opens all the way? Better open the seasonal shutter on the hot-air tube. Is the float level correct? If too high, slight flooding will cause an over-rich mixture.

6. Does the ignition system furnish a spark of sufficient strength? A weak spark due to excessive lubrication of the magneto, dirty breaker or distributor, or weak magnets, will have an effect similar to late spark timing and overheating will result.

7. Are the valve tappets properly adjusted? They should have from 0.008 to 0.010 in. clearance, which may be gauged by about the thickness of an ordinary post-card.

8. Are the cylinders free from carbon? If not, remove it.

9. Is the oil in the crankcase clean? Gasoline, dirt, or other foreign substances will impair the quality of the oil in the crankcase resulting in overheated parts due to insufficient lubrication. The oil reservoir should be drained every 1,500 miles, the walls thoroughly cleaned, and a fresh supply of oil should then be put into the crankcase.

10. Are you using the right grade of oil? Because of the increased temperatures it is often advisable in summer to use a heavier grade of oil than in winter.

11. Are the exhaust pipe and muffler clean? Practically 40 per cent of the heat of combustion escapes through the exhaust. It follows, therefore, that if any part of the exhaust system is obstructed, a part of this heat must be carried off by the cooling water, which will naturally raise its temperature.

12. Are the brakes free? A dragging break will cause overheating in hot weather that might not occur in cool weather.

Legislation Does Injustice to Truck Users

"Legislation limiting the weight of motor trucks should avoid working injustice upon truck owners and creating confusion when trucks cross state lines," says Mr. L. B. West, President of The West Construction Company, Chattanooga, Tenn. "Recently my own company invested $50,000 in 5-ton trucks and had no sooner put them in operation than state legislation was passed limiting the total weight of the truck and load to 7½ tons. It is a known fact that injury to the road is caused by the weight bearing upon each inch of tire in contact with the road surface.

"The only just and practicable basis of restriction is to provide a maximum weight per inch width of tire. The maximum weight adopted in a number of states is 800 lbs. per inch width of tire. If a standard basis were adopted by all of the states the truck manufacturer and truck user could proceed intelligently and without fear of having their product and equipment rendered almost useless by confusing and conflicting state laws. Traffic crosses and re-crosses state lines and it is an unjust absurdity for the owner of trucks operating legally in one state to find, as soon as he has crossed the state line, that he is subject to heavy fines and even imprisonment for using the same trucks in the same manner on identically the same kind of roads as characterized the other state.

"Not only do such conditions work injustice to the truck manufacturer and the truck owner but they are harmful to the taxpayer, for contractors cannot go in and compete in states where a large portion of their equipment may be barred from use and where the contractors who actually bid upon work are restricted to equipment that may not be operated as economically as the heavier units. Truck weight regulation is desirable, but it should be based upon a fairly well standardized conception of the justifiable limit in weight per inch width of tire."

EDITORIALS

THE GREAT AMERICAN DETOUR

Any discussion of present-day practice in laying out, marking and maintaining highway detours becomes an elaboration of the obvious, for it is the partial or complete failure to do what very obviously should be done with respect to detours that makes this a subject worthy of discussion.

Last month we called attention to a few of the fundamentals of this situation. Detours should never be inflicted on the traveling public except where absolutely necessary, and where they are imperative they should be made as short as possible and made and maintained as smooth as practicable. Where the detour is over an earth road this road should be properly maintained with the machinery commonly used on earth road maintenance. If a little-used earth road becomes a much-used detour, then money should be spent to put and keep it in good condition during its period of great usefulness, even if the money so spent is to secure merely a temporary benefit.

A variant of the "weakest link" truism is that a highway is no better than its detours. Recently we had occasion to drive 125 miles between two cities connected by a widely-known highway. Reports had it that this was an excellent hard-surfaced highway in this locality and that the speed with which it could be traversed was limited only by law, or by the best speed of a car, or by the driver's fancy. So the road was described; as found, it contained just five detours, three of which were long, rough and devious. That these detours fix the hauling limits for this highway is obvious, and it is also true that the speed and satisfaction with which this highway may be used with a passenger car are also limited by them. All of them were necessary because of construction operations and are mentioned merely by way of illustrating the statement that "a highway is no better than its detours."

It seems almost incredible that detours are not kept as short as possible, yet several times this season the local talent has assured us, at the end of an especially long and rough detour, that had we gone thus and so, contrary to the official markings, we would have had a shorter and smoother ride. In some cases this evidence was convincing in spite of its unofficial and hearsay character.

The marking of detours is often so carelessly done as to suggest to the bewildered stranger that the markings may be sufficient for those who reside in the locality, but they certainly are not sufficiently plain to serve the stranger's needs. Detours from highways known to carry tourist traffic should be very plainly and adequately marked from end to end. Detours so indifferently marked that they cannot be followed surely in broad daylight by a sober man of mature years and average intelligence, ought never be encountered, yet we have seen some of this description this year.

It is not an uncommon experience to be stopped by an approaching motorist on a detour and to be anxiously questioned by him as to the distance to the end of it. This has suggested that the total length of the detour should be posted on the end detour signs, and intermediate mileage markings would also be appreciated by many. It should be remembered that the anxiety of those who "watch and wait for the morning" is not greater than that of those befuddled and bouncing motorists who watch and wait for the end of a detour.

If there is one inexcusable and indefensible thing in modern detour practice it is this failure to mark them adequately, for any rodman, or common laborer or contractor's water boy, for that matter, should be able to mark a detour in a few hours and do the work so plainly that it would surely and safely guide the stranger. The expense of this would be as trifling as the time required. Fancy or expensive signs are not necessary. A pot of paint and a few smooth boards, if intelligently and carefully used, should serve.

Highway signs of any description should be on tall posts near the side of the roadway and not on short posts in a cluttered fence corner. These posts should be tall enough to attract attention by their height and close enough to the roadside to catch the tail of the eye. Signs on short posts in the fence corner are likely to be overlooked by the very persons to whom they are essential and for whom they are intended.

Highway sign posts of any sort, detour or otherwise, should be of square cross-section, or, if round, imbedded in concrete. The round, unanchored post is easily rotated through 90 degrees, and thus made highly misleading. One of the oldest pranks known to unregenerate youth is to "switch the arms on a guide post," the modern equivalent of which is to turn a round post and its sign through 90 degrees. This quarter turn is a bad turn for the stranger, causing him at least annoyance and delay and frequently serious trouble.

The entire detour situation, in some localities, is so discreditable as to be embarrassing to any one engaged in highway work or standing sponsor for it. Many of the irritations so caused are as unnecessary as they are inexcusable.

RECOMMENDED WATER WORKS PRACTICE

The Council on Standardization of the American Water Works Association is now in working order and ready to function. Provision has been made for the assignment of 15 hardy perennial topics to as many special committees. Year after year these topics have held the attention of water works men in convention assembled and many opinions have been expressed on each. There has been a wealth of information produced of great value to the studious and informed individual, but so abundant as to be quite overcoming to the well-meaning but uninitiated political maverick who has strayed into the water works field. What this man needs is not the accumulated literature of 41 years, but a simple, predigested code of recommended practice and procedure. The committees will undertake, in large measure, as we understand it, to supply this much-needed manual, chapter by chapter. It will be of the utmost value to a public which periodically turns its water works over to tyros and will free the worthy tyros from many blunders and foolish notions.

Out of the accumulated wealth of the past, in the form of data, discussion, opinion and description, will be crystallized, item by item, a dependable guide at once helpful and convenient to the experienced, a ready refuge to the inexperienced official in his hours of travail and perturbation, and, literally, a life-saver to that busy, well-meaning but uninformed group of people, expert in various other lines, but innocent of water works knowledge, referred to collectively as the "general public."

We bespeak for these committees the co-operation of all experienced water works men. Membership on one of these committees is an honor and a summons to perform a high duty.

FOR FAIR AND UNIFORM TRUCK LEGISLATION

Many motor truck owners are now confronted with a serious situation arising from ill-considered, makeshift and unfair truck legislation. In some places unreasonable restrictions have been imposed as to weight and dimensions of trucks and their loads, and forms of taxation are being devised that will actually force some trucks, and some truck owners, out of business. There are now four different taxes on trucks. Can the addition of other truck taxes have any other result than to make truck transportation financially impossible?

No one questions that trucks should be taxed, but they should be taxed in just proportion to the taxes levied on other means of transportation. Trucks should be taxed as a public utility and not as a public nuisance, the abatement of which is sought by taxing the cause out of existence.

Almost as important as fair legislation affecting trucks is the matter of uniformity in truck legislation. One of the oldest governmental evils we have as a nation is the lack of uniformity in state laws. There may be some excuse for the lack of uniformity of old laws, but what possible excuse can there be for a lack of uniformity in state laws enacted at this time, with all the evils of the old go-it-alone legislative system well understood? It is, of course, perfectly ridiculous for a truck owner to be a law-abiding citizen on one side of a state line and a law-breaker with the same truck and load on the other side of the line. Every truck is a potential interstate carrier, and the regulations under which it may operate lawfully should be identical throughout the country.

INDEX TO VOL. LX

The index to Vol. LX of Municipal and County Engineering, covering the period January to June, inclusive, 1921, is now ready for distribution, and subscribers who want a copy of it may obtain one free of charge by writing to the publisher.

UNIQUE METHOD OF ELIMINATION OF ODORS FROM INDUSTRIAL WASTES

By Harlan H. Edwards, City Engineer, Danville, Ill.

The dumping of household and industrial wastes into storm sewers has been a source of trouble for plumbing and sewer inspectors in many cities. In some cases this has created but little nuisance, while in other cases the mixture of the various types of wastes has caused the formation of very objectionable odors. Such a problem as this was presented to the engineering department of one of our small cities not long ago, and the method of elimination followed was unique.

The sewer in question was of the large circular brick type, 3 ft. in diameter, which received the rainwater and surface wash from a number of streets, through inlets which were not trapped to prevent the passage of air from the sewer into the street. Emptying into this sewer also was the sewage from a few residences that had become connected to the sewer at various times without the knowledge of the city authorities; the manufacturing wastes from a brewery and an ice factory, and the sour milk and floor washes from a creamery. The ice factory's hot water waste, combined with the creamery's sour milk and the brewery's bad brews, cooked up an odor that escaped from the inlets with an asphyxiating stench.

Not only was this objectionable along the street, but it was also very objectionable at the point of outlet of this sewer. The sewer discharged into a small creek which ran through the town, and which was dry during the summer. The discharge of the creamery and brewery waste into stagnant pools so concentrated the fearful stench that residences within a radius of several blocks were rendered almost untenable. Very little trouble and no complaint occurred as long as a flow of water existed in the creek, because the mixture coming from the sewer would be cooled and diluted sufficiently to keep down the odors. The problem, therefore, was to care for the flow of the sewer during dry weather, because during the period when water was flowing in the creek the sewer lost most of its objectionable features.

Preventing Escape of Gases

In order to overcome these conditions, the matter had to be attacked from two different angles. The first step was to prevent the gases from escaping into the street through the inlets; the second was to devise some means of disposal of the dry weather flow of this sewer. Both of these problems were solved effectually, while the cost did not prove excessive.

The method pursued to eliminate the egress of gases and vapors from the inlets was simple. It consisted in the installation of standard 10-in. vitrified tile traps, which were placed between the inlet and the sewer in the street and about 2 or 3 ft. below the surface of the ground. By the use of these traps, no gases could escape from the sewer on account of the water standing in the traps and sealing them at all times. It was feared at the time that the water in the traps might become frozen in cold weather, but after they had been subjected to the temperatures of one severe winter, no difficulty was found. It was feared also that the trapping of the inlets in this fashion would only serve to drive the stench to a point of escape through the many but unknown connections to the storm sewer, but so far no trouble has arisen.

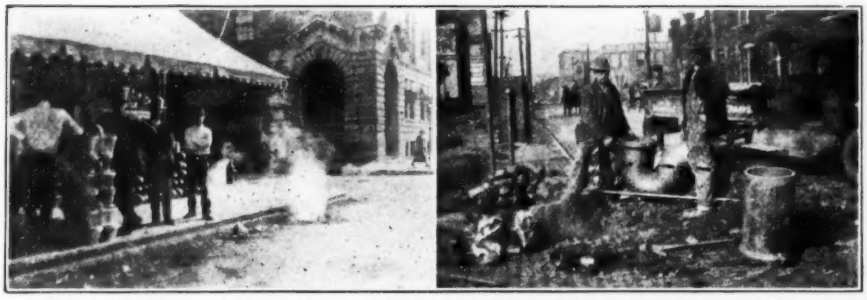


FIG. 1—PUTRID VAPORS FROM SEWER MADE NEARBY STORES ALMOST UNINHABITABLE. FIG. 2—WATER STANDS AT LEVEL OF DOTTED LINE IN THESE TRAPS, THUS PREVENTING ESCAPE OF VAPORS OR GASES.

Leaping Weir Utilized

This feature of the problem having been eliminated, the other and sometimes

more troublesome of the two was attacked. After some investigation it was found that one of the main sanitary sewers flowed under the mouth of the troublesome storm sewer, there being a drop of some 6 or 8 ft. from the storm sewer to the sanitary sewer. A hole was

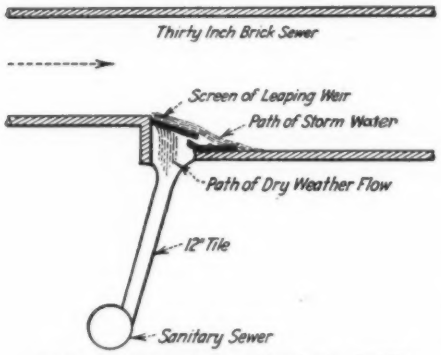


FIG. 3—SKETCH SHOWING OPERATION OF LEAPING WEIR IN SEWER.

punched through the bottom of the storm sewer and tile placed to form a connection that would let the sewage drop down into the sanitary sewer. While this would take care of the dry weather flow, it would also permit a great volume of storm water to enter the sanitary sewer during rainy periods. This was very undesirable. A leaping weir was therefore designed, so that all flows less than 30 gals. per minute would drop into the sanitary sewer, while all flows in excess of this would leap over this opening and pass on down to the creek. The bottom of the storm sewer was so cut away that this could be installed and some special castings were obtained to complete the design, which was proportioned in accordance with a formula derived as a result of a series of experiments made by Prof. H. E. Babbitt, in the Hydraulic Laboratory at the University of Illinois.

This installation has worked very well except for the fact that the grid or screen which was placed over the opening has caused a little trouble. At first this screen was placed at so steep a downward angle that it kept itself clean, but a sufficient amount of the dry weather flow trickled along the bars and escaped into the creek, renewing the nuisance during the hottest weather. The screen was then put in a flatter position, but while this eliminated the trouble from the sewage escaping into the creek, it introduced another problem in the clogging of the screen with leaves, paper and other debris brought down in the sewer. Experiments are now under way which will probably correct this troublesome feature. The leaping weir was first put into operation on a hot, dry day in August. Within 30 hours the bed of the creek was dry around the mouth of the sewer and the stench had disappeared.

TRAFFIC CONGESTION ON CITY STREETS FORCING MORE CAREFUL PLANNING OF STREET AND BOULEVARD SYSTEMS

By Charles H. Cheney, City Planner, Consultant to the Portland (Ore.) City Planning Commission, City Hall, Portland, Ore.

So suddenly has the age of the motor vehicle come upon us and so critical has the resultant traffic congestion become all over the world, that constructive steps to solve traffic problems are of interest to all cities. While temporary regulations, one-way traffic and other makeshift measures are being tried out, no permanent solutions have been found to compare with the linking up of a few

FIG. 4—VIEW OF LEAPING WEIR. DRY WEATHER FLOW DROPS THROUGH THIS GRATING WHILE LARGE AMOUNTS OF RAIN WATER PASS OVER IT AND FLOW DOWN THE SEWER. FIG. 5—THE GRATING CLOGS SOMETIMES WITH LEAVES, STICKS, RAGS, PAPER, ETC., WASHED INTO THE SEWER.

wide, direct, conveniently located thoroughfares connecting all parts of the city.

Traffic congestion is forcing more thorough and careful study of street conditions, both as to what we have now and what we must anticipate in the near future. St. Louis in 1917 completed a major traffic street plan, in following which millions of dollars are now being spent for widenings and openings, because they will pay. Detroit, Chicago and many smaller cities have their problem well in hand.

The Major Traffic Street and Boulevard System Plan recently adopted by the City Planning Commission of Portland, Ore., after two years of study, is expected to do much for that city.* The problems met are typical of most of the cities of the country, and therefore of general interest.

Reasons for a Major Traffic Street Plan

It is more and more evident that in the future through travel should be limited to a few conveniently located traffic streets, on which ordinary drivers, once in the stream of travel, can know that they are safe, and move steadily ahead, and on which reckless ones can be more easily and economically regulated.

Commercial vehicles and hauling should be limited to a few definitely established major traffic streets until they have reached the nearest point to their destination. Only thus can we furnish enough heavy traffic pavements to satisfy traffic needs, or pay the bills for their making and upkeep.

Approval of the City Planning Commission is required by State law in Portland, as in many other cities of the country, on all maps of new land sub-divisions, both within the city limits or for six miles outside. In passing on the 26 such maps submitted to it during the past 18 months, the Portland commission found that it must have a general plan of major traffic streets, or through leads for its guidance. The Major Street Plan just adopted is comprehensive and will serve to convince owners of new tracts as to the necessity of a few and continuous through streets laid out in advance.

The wear and tear is so great, the danger to children and pedestrians so serious, and the cost of permanent wide traffic pavements and their upkeep so large, that cities can afford to have only about every sixth or eighth street established and paved as a traffic street.

The greatest number of street accidents today are caused by reckless turning in or crossing at side streets. Once a comprehensive system of Major Traffic Streets is settled on all cars can be required to come to a dead stop before turning from a minor, or side street, into an established traffic street. Chicago already has such a system partially in effect. The Police Traffic Bureau and City Planning Commission recommend it for Portland.

Streets Should Be Arranged to Suit Their Use

During the past 15 years the coming of the fast motor vehicle, with trailers, carrying heavy loads, amounting sometimes to as much as 10 or 12 tons on two wheels, has made necessary more permanent and heavy hard surface pavement, and more direct through routes. These form the Major Traffic Streets.

The balance, or minor residence streets, comprise 85 per cent or more of our total system in most cities. For these minor streets Portland has adopted a minimum roadway between curbs of 20 ft., thereby making a saving of $112 a lot in paving cost, and it is expected that these narrow roadways will be safer, quieter, less attractive to speeders, and yet take care of all the traffic which originates or ordinarily has business on them. The Portland commission found that millions of dollars of needless and over-wide paving has been put down on such streets in the past, and estimates that several hundred thousand dollars, at least, will be saved taxpayers in the next five years, on new paving, by settling now which streets will not be needed for through traffic and wide pavements.

With a complete system of traffic streets decided upon, minor streets can be closed in industrial zones without question, wherever so desired for business reasons. Fewer cross streets in residence districts would reduce the cost of land, by eliminating the land lost in such streets, and their paving cost. Portland has 200 ft. square blocks in a large part of the city, and the closing of alternate minor cross streets is recommended. Home ownership was found to be discouraged and possibly seriously deterred by the unnecessary burden of overwide street paving on minor streets in the past.

*NOTE—Figures quoted here are from the comprehensive "Major Traffic Street Plan, Boulevard and Park System for Portland, Oregon" report, recently issued by the Portland City Planning Commission.

In paying for paving on traffic streets through valued residence districts it was recommended that the abutting residence owners be not required to pay more than they would have to if located on a minor street, a benefit district on either side and the city or county out of its general fund making up the difference.

What a Careful Traffic Census Shows

Graphic illustration of the congestion points, irregularities and traffic difficulties of Portland were shown by diagrams of flow of vehicular traffic, street car traffic and downtown pedestrian traffic, made from traffic counts for typical days kept by the City Engineer's office. From these charts and other data collected, the following facts stands out:

1. Motor vehicles have come into use in much larger numbers than the horse-drawn vehicles they supplanted, requiring wider and heavier pavements.

2. Where there were but 2,493 motor vehicles registered in Oregon in 1910, there are 103,650 in 1920 (one-third in Portland). Twice as many may be expected in five years.

3. Street accidents in Portland have increased from 2,244 in 1917, to 8,379 reported in 1920, and over 1,000 for the month of January, 1921. Twenty-five persons killed and 1,121 injured was the 1920 toll for this city of 260,000 population. Other cities of the country are in proportion. One hundred dollars average damage in each accident might be a conservative estimate of property loss.

4. Vehicular traffic across the five bridges increased nearly four times in seven years, from 11,902 daily total in 1913, to 46,282 in 1920. This explains the traffic congestion downtown, which has grown in proportion.

5. Pedestrian traffic on the bridges meanwhile decreased from 28,389 in 1913 to 20,514 in 1920.

6. The diagram of vehicular traffic showed a few streets leading to the bridges, which do the greatest work, and therefore need to be widest and have the heaviest pavements. Greatest congestion appears at the bridge approaches, which are most in need of relief by enlargement and separation of grade crossings.

7. Certain bridges do not carry their fair proportion of the traffic seeking the center of the city and new diagonal street approaches should be arranged for them so that they may do their share.

Traffic Delays are Costly

"The problem of transportation within cities is one of rapidly increasing importance, yet one which has attracted very little attention," says J. P. Newell, Consulting Engineer and former President of the Clity Planning Commission, in an introduction to the Portland report. "Much thought has been given to the transportation of goods, but I refer to the movements of the people themselves. Probably 125,000 people move a distance of a mile or more and back again in Portland each day. Save one minute each way for each person and you have 250,000 minutes, worth at least $2,000, or 6 per cent on $10,000,000. Does any one ever make such a trip without at least one minute's unnecessary delay?

"We are apt to overlook the fact that the probability of a delay is almost as bad as the certainty, in wasting time if one must get to work or keep an important engagement; he must allow for probable delays just as though they were sure to happen. A city is a great workshop, and ease and freedom of movement of its people, are as important, even from a financial standpoint, as to the workmen in the factory. Delays increase, according to the square or the cube or the nth power of the population."

Certain fundamental considerations, to be taken into account in the preparation of a Major Traffic Street Plan, include ultimate railroad terminal and belt line service, re-location of rapid transit lines finally to do away with grade crossings, elevation of bridge approaches over the railroads, and water-front hauling streets, the establishment of probable future bridge locations, water-front improvements, etc. The report on unification of railroad lines presented to the National Conference on City Planning of 1920, at Cincinnati, was used as a basis for studying these items in the plan, Mr. Newell and Mr. Cheney having been members of the committee presenting that report.

The Portland report includes a program for rebuilding two large existing bridges across the Willamette and for adding four new ones at the intervals when it is estimated they will be needed, between 1922 and 1940.

Three Kinds of Streets Found Necessary

For economy, safety and convenience it is necessary to divide all streets into three general classes, according to their use.

1. *Major Traffic Streets and Thoroughfares* should be located to give direct access by shortest route, carry unlimited traffic and be unobstructed as far as possible by street car lines or railroad grade crossings. They should be not less than 80 ft. in total width, both within the city

and leading out into the country for an average of six miles. In Portland some eight principal thoroughfares of 100 ft. in width are recommended, and waterfront hauling streets of 120 ft.

2. *Boulevards and Parkways* should be indirect in route so as purposely to avoid being later appropriated as traffic routes, and should exclude commercial vehicles and truck hauling. Direct routes should only be adopted when closely paralled by a Major Traffic Street.

It is a well understood practice, in cities having developed boulevard systems, that all boulevards should be not less than 150 ft. wide and preferably 200 ft. wide. This width is necessary to secure ample permanent parking strips for double or triple lines of trees on each side of the main roadway. Such parking and planting are what make a boulevard desirable, refreshing and useful, as distinct from ordinary or traffic streets.

"It is an abuse of language to call a street of ordinary width a boulevard. A street 100 ft. wide would be a street or avenue of handsome width, but a mean boulevard. As residence streets commonly have two rows of trees, a boulevard should have at least four rows, and should be wide enough to accommodate them properly. A width of 150 ft. would generally be a minimum for a boulevard.

"In the case of boulevards and parkways, the houses should be set back 25 ft. or more from the sidewalk, and suitable legal methods for securing this should always be adopted at the time of laying out a boulevard or parkway."*

The Boulevard System Plan should be carefully checked on the ground and provide a complete system for ultimately encircling the city with several loops linking up with existing boulevards, to show off to advantage the finest public buildings, parks and scenery the city has to offer, on routes that will be the most economical to acquire and build.

Business should be prohibited by Zone Ordinance on all real boulevards of the permanent boulevard system.

3. *Minor Residence Streets*, which comprise about 85 per cent of the total in the city, should be protected from the intrusion of needless traffic, to preserve the safety, quiet and comfort of people living on them. Forty and 50 ft. streets should be accepted, where building set back lines are permanently established by the city in the future. They should be paved with 20 ft. roadways or less, except where there are street car lines.

Like most cities Portland is already compactly built up downtown, and for a considerable distance out from the main center. Changes in streets, in these portions of the city at least, would be expensive and can only be undertaken where relief from present or future congestion make them imperative. In the Major Traffic Street and Boulevard System Plans adopted, every widening, extension or new street proposed has been carefully weighed by the City Planning Commission, as to its practical purpose and value, and only such proposals included as seem justified in cost for relief of traffic congestion.

This plan does not contemplate all these improvements at once, nor for some time to come. In fact, most of the widenings shown as ultimately necessary may be put off for one, and in some cases two, decades, if the recommendations made as urgent are put into effect reasonably soon, and always in accordance with such a pre-determined plan. Establishment of 10 ft. building set-back lines, on each side of many of the Major Traffic Streets now only 60 ft. wide, will suffice for a number of years.

Benefits Expected from Adoption of a Major Traffic Street Plan

J. C. Ainsworth, prominent banker and president of the Portland City Planning Commission, says of this report, "The Major Traffic Street, Boulevard and Park System Plan will go far to solve many of the city's most serious problems.

"This plan, if adhered to, will save thousands of dollars of needless overwide street paving, by designating the 85 per cent of our streets which will not be needed as through traffic streets.

"It will help the small home owner by establishing definitely the minor residence streets, where the burden of paving can be cut in half.

"It will save more money by stabilizing the downtown centers of traffic, thereby preventing unwarranted shifting of the retail center, with consequent depreciation and loss, while allowing for reasonable expansion of the business district in all directions.

"It will save time for every one, by relieving traffic congestion in all parts of the city.

"It will increase safety on our streets and should reduce street accidents by half, by establishing traffic streets at which a dead stop of all cars turning in

*Olmsted Bros., in report on Spokane Boulevard and Park System.

from side streets can be required, as in some eastern cities.

"It provides a system of boulevards, passing all the principal points of interest in the city and making the most of Portland's scenic attractions. The linked-up systems of highways, city and mountain drives provided, will attract tourists from all parts of the United States.

"The carefully selected locations for playgrounds and parks will save thousands of dollars to the city and the school board by eliminating duplications in playground and field house facilities.

"A comprehensive and practical plan of development is provided for us all to work to, so that investors may know where traffic is going and build accordingly."

SUCCESSFUL AMERICANIZATION WORK IN AN INDUSTRIAL CITY

By Bernice C. Skidelsky, of Community Service, 1 Madison Ave., New York, N. Y.

There is a spirit of good fellowship in Whiting, Indiana, that bids defiance to rivalry in any other community. The town will "meet all comers" in this respect, and fight them at least to a draw. It hasn't always been that way—but then that's the story.

The first settlers of Whiting made their way there about the middle of the past century. They were hard-working, earnest folk, of that solid and reliable stock known as "pioneers"; and sharing common dangers and common hardships in the process of wresting the unknown soil from a state of wilderness, they shared also a mutual friendship and esteem that made the little settlement like one large family.

About forty years later, the Standard Oil Company came to Whiting. It erected a plant there, and brought to its doors great numbers of foreigners, excellent people and worthy laborers, but unaccustomed to the ways of their neighbors, suspicious of them, and possessed of marked tendencies to segregate into small groups within boundaries of nationalities. Each little group had its own church, round which centered activities which were replicas of the activities they had known in the mother countries.

As a result, Whiting, which had been as sturdily American a community as one could find from coast to coast, suddenly found its unity gone and in its place a hodge-podge of unrelated cosmopolitanism that was vastly different from the old happy state of things.

Within 20 years, Whiting reached a census of 9,000, with 65 per cent of its population foreign born. Most of the industrial interests centered about the Standard Oil plant, but socially, the people of the town had not yet got together.

So matters stood in 1919, when a group of citizens of the community got together and discovered, as is so often the case, that the deficiency was not in the matter of good will, but in a lack of the knowledge of how to go about effecting the desirable change. The result was that they called into consultation a representative of Community Service, who was experienced in community service work among non-amalgamated groups.

The worker found the streets alive with children, playing as best they could in face of a lack of play facilities. He learned, also, that there was a very fine recreational park over at the Lake Front; but unhappily this was of little use, except on special occasions, because a number of railroad tracks lay between it and the heart of the town, so that the mothers had forbidden their children to go there unaccompanied.

But the most important thing he found was that the people were perfectly ready to co-operate. The Standard Oil Company presented a site for a community house, conveniently located in the center of the town and in the midst of the foreign groups. Since many young men of Whiting, Indiana, had given their lives on foreign battlefields, it was decided to make the house a memorial; and a vote of the town officials set aside $400,000 for the house and its fittings.

It then became a matter of execution. An architect was employed, and plans for the house got under way. Meanwhile, since the company had provided a small portable house to serve as temporary headquarters, recreational activities were planned and carried out. The first step was to organize an athletic association of 4,500 employes in the Standard Oil Company itself. This formed a nucleus, from which branched out other organizations including all men and women and children of the town. Community dances came soon, and were highly successful. Community singing was introduced, and as always it proved to be one of the most efficient methods of getting people together. An exhibition was planned wherein the foreigners could all come to-

gether in the common bond of handicraft, each with specimens of his own native work. A citizenship class was formed; and efforts were made to reach the women in their homes, since it was a little difficult to get some of them out into more public interests.

The Board of Public Works co-operated by erecting toboggan slides in various sections of the city, and flooding a portion of the city park for skating. The Community House provided games and books. A "story hour" on Friday afternoons brought youngsters in scores. Indeed, it is asserted that Whiting's kiddies now "count their weeks by Fridays."

The children wanted to get in on the dancing, too. But it wasn't considered advisable to admit them to dances held for grown-ups, so special classes in aesthetic dancing were organized; and these vie with the story hour in popularity.

The organizer suggested a formation of a "Community Service Club" to carry on the work so auspiciously begun, which was forthwith accomplished. Christmas of 1919, the first of the club's existence, witnessed a demonstration that Whiting had again become one, for it was celebrated by a pageant that gave opportunity for everyone's participation. The special contribution of the Polish group for instance, was some very fine choral music.

So Whiting has become a unit again; it is no longer "Little Italy" and "Little Poland" and "Little Lithuania," and so forth, side by side in narrow town confines, but an American city, all the richer and stronger because it has known how to blend for its own best growth its diversified elements into a single whole.

U. S. BUREAU OF PUBLIC ROADS FAVORS FREE COMPETITION BETWEEN MATERIALS OF CONSTRUCTION

The following statement on the policy and procedure of the United States Bureau of Public Roads was issued recently by T. H. McDonald, Chief of the Bureau:

The mileage of Federal aid roads which have been built or are now under construction, is nearly sufficient to encircle the globe. This is the record of work accomplished since July, 1916, when the Federal government first stepped in to aid in the enormous task of building highways that are now called upon to carry more than 9,000,000 motor vehicles, plus a very substantial horse-drawn traffic in the forty-eight states.

The Federal aid law is well named, The Department of Agriculture has given the broadest possible construction to the law for the purpose of providing the greatest mileage of highways suited to the traffic to be carried over them, at the minimum expense. An analysis of the projects under contract shows that all types of roads, from the graded earth road to the finest paved surfaces, have been built.

On March 1 of this year, 22,030 miles of highway, extending into every state, had been completed or were in process of construction, at a total estimated cost of $361,946,868. The percentage of this total estimated cost which will be incurred for each type, and the mileage of each type, based upon the records of plans approved, are as follows:

	Per cent of total estimated cost	mileage
Type 1, including earth, sand clay and gravel....	32.2	15,300
Type 2, including water bound and bituminous macadam	9.0	1,530
Type 3, including brick, bituminous concrete, Portland cement concrete...	48.8	4,890
Miscellaneous	4.0	310
Bridges	6.0	.....
	100.0	22,030

The States initiate the road projects, but before Federal aid is granted, an engineer of the Federal Bureau of Public Roads makes an inspection of the roads to be improved, studies the local conditions, consults with the State Highway Department, and no projects are approved which are not considered suited to the conditions to be met. Many popular fallacies exist as to road improvement, and there have been many misconceptions as to the types of roads on which Federal aid funds may be used. Properly built earth roads are the fundamental requirement in all highway improvement. Regardless of the material or type of surfacing which is to be placed, the preparation of the road bed requires the highest engineering skill and experience. The department considers that the use of adequate sums for the securing of proper location, thorough drainage, permanent bridges and culverts, and the elimination of railroad crossings is demanded if enduring improvements are to be the result.

Federal aid is allotted to the improvement of earth roads, but only with the stipulation that a suitable surfacing will be placed as soon as funds become available. This allows the road bed to be prepared and become thoroughly consolidated before the surfacing is placed, which is highly desirable from a construction viewpoint. To follow such a course, however, is out of the question when a road is heavily traveled and some form of surfacing must be provided. To care for traffic under these conditions, frequently a sand-clay or gravel surfacing is provided, which will serve for several years and yet allow the road to be maintained under reasonably heavy traffic. Granting that the preparation of the road bed has been properly done, many kinds of road surfaces will give excellent service. The element of time is important. There are so many miles of roads to be constructed, and their cost will be so enormous that the most careful and detailed study of each road project must be made to provide, at the lowest possible cost, roads which will give satisfactory service and which can be maintained without undue depreciation under the traffic which is to use them. Many times the question has been asked the Bureau: What type of road is best? The answer is always the same: There is no one best kind or type of road surface.

A recent statement issued by the officials of the Bureau expresses this thought in the following language:

"It is the policy of this Bureau to consider the conditions on each individual Federal aid project, as there are elements such as subgrade, drainage and present and prospective traffic, which vitally affect the determination of the standards of construction to be used."

That is, there must be a careful analysis, both of the engineering and economic conditions for each particular case to determine the kinds of materials that can be used successfully, and after these facts are determined then the various types of construction which can be used economically should be brought into competition to secure the best possible results. There have been occasional attempts to write into State laws or the governing conditions of bond issues a requirement as to the type or kind of roads to be constructed. To follow such a course would be most unfortunate. The cost must always be considered in determining the type of road surfaces which are selected, and the allowable cost must be determined by the traffic which is to be borne. Local conditions vary to such an extent that very careful consideration must be given each project before determing the character or type of roads to be built. This principle was recently expressed to a Chamber of Commerce, asking for information, in the following language:

"Types of highways should not be specified by law. This is a matter to be decided by the State Highway Department in which should be lodged full authority, both to construct and to maintain. Competition between different types of material should be maintained and selection made to fit traffic requirements in each case. The Bureau does not recommend any one type to exclusion of others."

OBSERVATIONS ON THE HUMAN SIDE OF ENGINEERING

By W. W. Horner, Chief Engineer of Division of Sewers and Paving, City Hall, St. Louis, Mo.

(Editor's Note: These observations on the human side of engineering are from an address by Mr. Horner before the Engineering Freshmen at Washington University as abstracted in a recent number of the Journal of The Engineer's Club of St. Louis.)

It is quite customary, whenever we feel dissatisfied with the progress of the engineering profession, to get a group of engineers together and debate the question, "What is the matter with the engineering profession?" Of course, it is a healthy sign when we realize that there is something the matter with the engineering profession, and we always manage to crystallize our ideas somewhat by these discussions. What I may have to say might have resulted from such a discussion. I have not prepared a finished lecture, or even a completely connected talk. It is merely a series of unrelated impressions.

The engineer is primarily a salaried man, as compared to the lawyer or doctor, who are generally in independent practice on a fee basis. The engineer, therefore, is generally a subordinate, and a subordinate, in the lower grades, to the members of his own profession, and, in the higher grades, to non-technical officials, either public or industrial. This condition undoubtedly brings about a state of mind which accepts subordination

to some extent, and hesitates to take primary responsibility. This again reacts to prevent the profession as a whole from achieving a ranking position in the life of the present day.

I think that the engineer is somewhat handicapped in his relation to his fellow men, through his appreciation of the great natural forces with which he comes in contact. He is thoroughly impressed with the wonder of the universe, and the great physical laws, and is inclined to feel, subconsciously perhaps, that the human being in general is of small account in the great scheme of things. This must result, to some extent, in minimizing the value of the individual human being, and certainly goes a long way to prevent the development of personal self esteem which is one of the great assets of the average public man.

The surroundings of the engineer have changed in the last generation. In the last century the engineer was looked upon as a rather romantic character. He was a pioneer. Even recently, in an address to the American Society of Mechanical Engineers, Samuel Gompers said, "Engineers are the scouts of civilization. We send them ahead into the lone places, the wilderness, the jungles, and the great waste expanses, to build the necessary highways for civilized man." This conception of the engineer was general when civil engineering embraced the greater part of the profession. It undoubtedly had a great appeal to the adventurous disposition and rough character, and resulted in bringing into engineering a class of men who were natural pioneers. The survivors of this class today are our great old men of the profession.

The development of electricity, and the great industrial phase of American life, has called for a different type of engineer. There is little of the pioneer among men of the electrical and mechanical branches. The civil engineer already has been called into many phases of the congested modern life, and has lost a great deal of the pioneer spirit. We still have the miner, the irrigation, the water power man, and a few other smaller groups, to continue the romantic aspect of the profession, but we are now primarily concerned with industrial development and operation, and, although we do not appreciate it, with the details of modern life and human affairs, contact and reaction, as our psychological brothers would call it. This changed condition is not peculiar to the engineering profession, but is very similar to the situation which has abolished the romantic war correspondent of Richard Harding Davis fiction, and replaced him with the reporter or historian of the headquarters office. It is reflected also in the changed status of the soldier himself, who is no longer engaged with the heroic charges, and intricate minor strategy of other days, but must plan and execute human slaughter on a large scale. They are all merely signs of the times, but it is of vital importance that the engineering profession, and especially the new man going into the profession, appreciate this changed condition, and be prepared to assume the different responsibilities.

The engineering profession still maintains the respect of the people at large. It is considered conservative, solid and safe. Unfortunately this conception is reacting against the personnel of the profession. It is bringing to the engineering schools a great many men of small souls, who are seeking a safe living. It is quite too common to produce graduates who feel that their four years in college have earned them a right to a superior position, regardless of further activity. These men are our intellectual snobs. They are appalled at the ignorance that they find around them, and are continually making the mistake of underestimating men who have not had their advantages. I cannot help feeling that the profession is unduly burdened by men of this type, men who are natural subordinates, and yet jealous of their own subordination. In the present-day struggle it is not sufficient to be safe and sound in our ideas and activities, but it is necessary to take a leading part, and a progressive part in the industrial and business world, or to be relegated to the category of recorders and computers. There are, unfortunately, too few engineers who are either able or willing to undertake this struggle for the initiative.

Engineering is a science. In college we learn the basic branches. We learn something about the application of the facts, and we acquire a great deal of general information as to what has been done in engineering operations. In a way we acquire the simpler tools of the profession, and learn a very little about handling them.

The engineering graduate can delib-

erately choose from a considerable variety of work within the limits of the profession. He will be fortunate if he is able to analyze his own temperament and to choose correctly. There are fields of activity in the beginning which vary all the way from research, through design and application, to the direction of construction and operation to general management which may not be technical in any respect.

There is a great field for the engineer who is primarily a scientist, a research man. Engineers are criticised today for being individualists. It is said that they like to work separately, and to work directly with nature. This is the thing that the research man can do. He is the one engineer who can live the solitary life and still be successful. The man going into engineering, however, who feels that his temperament would incline him to take up this branch, must appreciate that just as his work will be independent and isolated, and, in a measure, free, so it will be unknown, and not to a wide extent appreciated, except in the case of great discoveries. As a result it will naturally not be highly paid. For the man who has a scientific temperament, however, who feels that he has gone into the engineering profession as a service, and who is either able or willing to accept a moderate recompense, research work will open a very great and wonderful field of activity.

I know of no other branch, however, where relatively complete freedom of activity is possible. To the mind of the man of high ambition and broad perspective the work of detail design and computation, the accumulation of data and details of analysis, are but the acquiring of greater facility in the use of the tools of his profession. To pass through these phases of engineering activity produces a wider knowledge and a greater confidence in his own ability.

Many men are satisfied with this phase of engineering. They mistake the tools of the profession for the end to be achieved, and, feeling a very just pride in their part of our technical life, become complacent. They are the great mass of our middle class or subordinate engineers. This class is essential to the progress of engineering work, and it is vital that we should bring into the profession a reasonable number of men who can do the detail work well, and be satisfied in the doing. In the end, they, too, must agree to a moderate recompense. This work, also, is in the shadow, and the public must be educated to appreciate its value.

It should be the great duty of the leaders of the engineering profession today to see that these two classes of engineers do not so dominate the profession as a whole that the popular conception of engineering will be limited to them. I think that the engineering schools have two great possibilities which lie at the root of the profession. First, to encourage the development of the executive ability of all those who have it in them, and, second, to help create a conception of engineering which will draw to the profession men of the highest type of mind. It is unquestionably true that the general standing of the profession, and the advantages to the individuals in it, will depend almost entirely on popular appreciation, or the popular conception of it as a whole. Just as I have tried to indicate that we have failed somewhat in recent years to attract the best minds to the profession, so has the profession suffered in the popular mind by comparison.

Where the young man thinks at all of his own native ability, the man of nimble wit and argumentative mind goes into the law. Too often the engineering profession will attract those who feel themselves lacking in both qualities. Fortunately for the profession, however, those who go in after a clear analysis of their own ability are few. We are lucky in getting a lot of good men who think they should be engineers because they have a faculty for mathematics, or enjoy tinkering with the front door bell. It is out of this class, the fellows who just happen in without knowing exactly why, that we should hope to make our best finds. If we can only pick the individuals from this group who have the native ability for mixing, who have an instinct for salesmanship, and then teach them engineering, we will get more and more great engineers. For, in the end, beyond the advantage of his fine mental training, the engineer's opportunities for ultimate advancement and service are not greatly different from those in the mercantile, commercial, or strictly industrial fields. The man with the same ambition, the same mentality as an engineering graduate, has a better chance to be president of a railroad or of a steel company than he would have had if he had not studied engineering, and when he arrives at that end he has every

chance of being a much better president.

At the risk of boring I cannot avoid repeating the one thing we hear most often directed towards the young engineer, that is, that the man who intends to attain high position cannot afford to neglect the cultural side. As he must be able to sell himself and his engineering all the way up the ladder, so he must be able to take his place among the most broadly educated men at the top. The engineer should know something of art and a great deal of literature. He should have a fundamental knowledge of law and economics. He should, above all things, be able to write good English, and, if he is physically able, learn to speak it, and speak it in public without effort. He should develop an interest in people, and train himself intuitively to analyze character. He must appreciate that every single act is a part of some broader policy, and to understand when determination is truly effective and when it degenerates into mere stubbornness. He should learn to cultivate the practice of diplomacy, and should study the psychology of organization and management. All of this is on the human side, and all is necessary, because he can never be a big engineer unless he is, in a sense, a big man. It has seemed unnecessary to say much about the knowledge of pure engineering. The necessity for this should be taken for granted. As an eminent engineer recently said on the technique of engineering reports: "The first essential in report writing is for the author to know what he is writing about, and know it thoroughly and definitely."

There is no doubt that we are still in the beginning of the great engineering era. The engineering profession has now a higher standing and a broader appreciation than it has ever had, but it has not developed in accordance with its opportunities, possibly because of the inherent defects in its personnel, which I have attempted to outline, and partly because the big affairs of the country have been in the hands of interests thoroughly intrenched, and to some of which it has seemed better to keep the engineer as a servant rather than to take him as a partner. To complete the necessary change in the status of the profession, the engineers generally will have to realize their public position and act accordingly. If we would only understand how thoroughly every lawyer is in politics, and how completely the medical profession is interested in public affairs, we would realize better how necessary it is to impress upon the popular mind an appreciation of the value of engineering. It is not uncommon to hear a young lawyer say, "I haven't decided whether I shall practice or go into politics." It is more common to hear the engineer remark, "I am not sure whether I shall ask for a job at the waterworks or go with the railroad." One possesses vision, the other is still without purpose.

CONFERENCE ON ENGINEERING SOCIETY CO-OPERATION

An informal and unofficial conference of representatives of the American Association of Engineers and the American Engineering Council was held at the Hotel Statler, in St. Louis, on June 3 prior to the meeting of the Executive Board of the Council on that day. Mr. E. S. Carman issued the invitations to the conference, which included, besides himself, H. O. Garman, L. W. Wallace and C. E. Drayer. The conference was for the purpose of finding a way to develop closer relations between these two national organizations.

The following conclusions were reached unanimously:

1. This conference is unanimous in the opinion that there should be unity in the profession.

2. It is agreed that duplication of effort by the two organizations is undesirable on account of economic waste.

3. The discussion of the morning developed the desirability for the creation of conference committees to consider closer cooperation between Federated American Engineering Societies and the American Association of Engineers.

At the morning session of the Executive Board of the American Engineering Council Mr. Carman proposed the appointment of a committee consisting of the presiding officer, the secretary and one other member of the Executive Board to consider closer cooperation between the Federated American Engineering Societies and the American Association of Engineers. After considerable discussion, motion was made to read that a committee consisting of the presiding officer, the secretary and one other member be appointed to confer with representatives of A. A. E. and report back any recommendations it may see fit. The presiding officer, Calvert W. Townley, appointed Dean Kimball, of Cornell University, as

the other member of the committee. During the discussion of the motion it was apparent that some of the board favored any reasonable basis of cooperation, but the majority stood squarely on the position that closer relations could be brought about only by the American Association of Engineers joining the Federated American Engineering Societies on the same basis as the other national societies, which were constituent members.

USE OF ASPHALT MACADAM PAVEMENTS IN REAL ESTATE DEVELOPMENTS

With housing conditions throughout the country only slightly improved, especially in the larger cities, and with the continued desire on the part of most city dwellers to have their homes in suburban or residential sections, instead of in the heart of a city, the subject of developing new residential areas has come to be of great importance among city engineers and city planners.

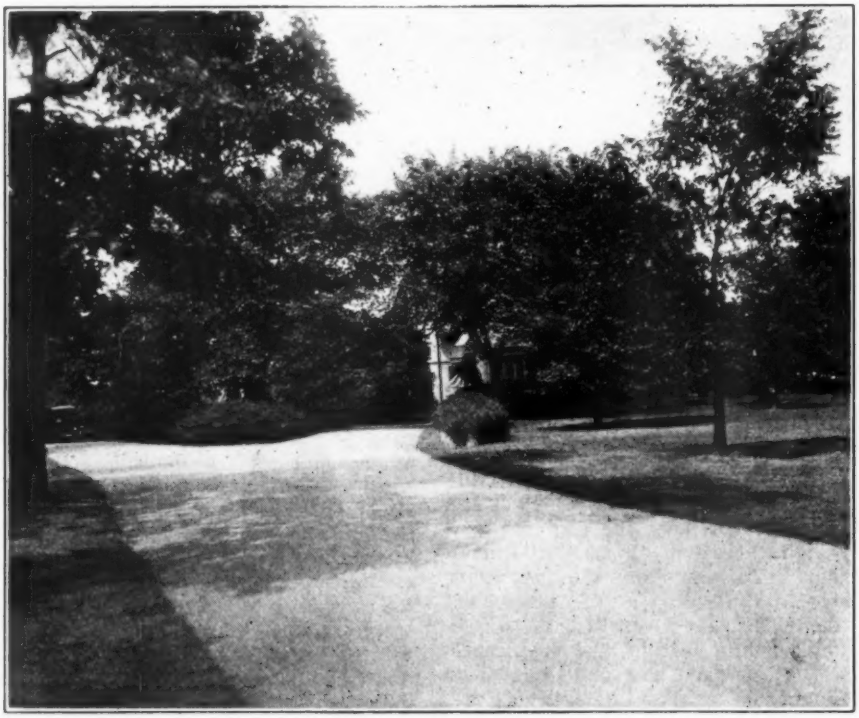
To be successful, new home areas must be beautiful and attractive, as well as within a convenient distance of the average person's place of work or business. In making these new real estate sections beautiful, realtors and city engineers have found that the problem of paved streets is one of the first to be solved; and after considerable study and planning, they have decided that the type of pavement in a newly developed home area must have these features:

1. A pavement easily and quickly constructed.
2. Economical and low in first cost.
3. Beautiful in appearance and suitable for the traffic it is to undergo.

Asphalt Macadam a Suitable Type

A pavement which has all these features and has proved it is ideal for the purpose is asphalt macadam. Extensive use of it during the last decade has resulted in its adoption by many towns and municipalities, as well as by real estate concerns, to pave newly developed residential districts. Among the cities that have used it are Asheville and Charlotte, N. C., Baltimore, Md., Chicago and many others.

Although the daily traffic over a street in a suburban or residential district includes numerous vehicles, yet the type of traffic is not the heaviest. It usually in-



PRIVATE ESTATE OF GEORGE A. McKINLOCK AT LAKE FOREST, ILL., SHOWING A TEXACO ASPHALT MACADAM DRIVE.

cludes pleasure automobiles or light commercial delivery machines. Therefore, a more permanent type of pavement, like sheet asphalt, is not required and the extra cost would not be justified. Consequently asphalt macadam has been most satisfactorily used, because it is durable and lasting under the type of traffic specified, and in addition provides a beautiful, noiseless, waterproof pavement, perfectly adapted to the aesthetic surroundings of a residential or suburban district.

Roadways on Private Estates

This type of pavement has also been used extensively in and surrounding large estates and country homes, because of the facility with which it is laid and the excellent manner in which it harmonizes with the usual charming surroundings of such places. Several of the most popular real estate developments near Charlotte, N. C., were paved in 1916, with Texaco Asphalt Macadam by the penetration method, and the streets in this locality have given excellent satisfaction. There are many blocks of the same type of roadway in the fashionable Grove Park section of Asheville, N. C., and the attention of public officials and real estate concerns throughout the country is being directed to these pavements as an example of how asphalt macadam may be used in developing new residential areas.

How to Build an Asphalt Macadam Road

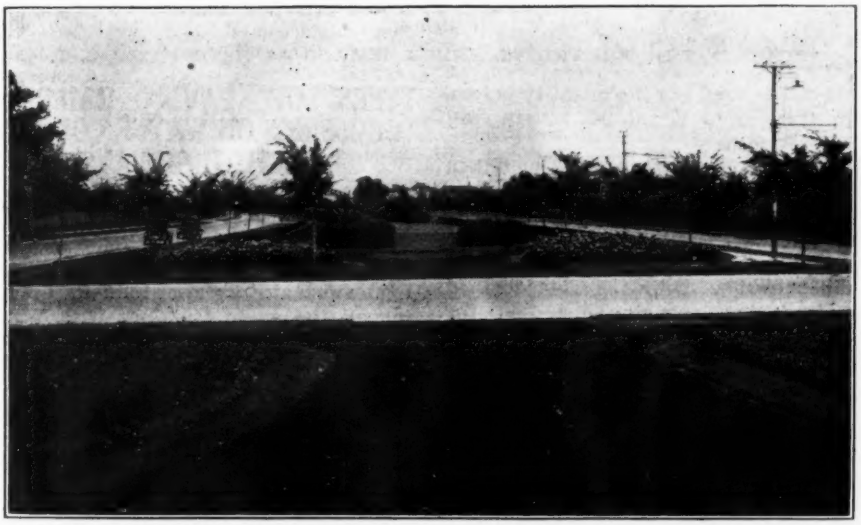
There are two main parts to an asphalt macadam pavement: (1) The foundation; (2) the wearing surface.

The foundation may be either of the following: Macadam or gravel. Irrespective of type, the foundation should be solid, compact and of sufficient depth, and the subgrade under the foundation should be well drained and solid.

Two main materials make up the wearing surface of an asphalt macadam pavement: (1) Broken stone; (2) asphaltic cement.

The steps in constructing the wearing surface are as follows:

1. Spread clean, coarse, broken stone over the foundation. This stone should be from 1 to 2½ ins. in size, and should be spread so as to give a minimum thickness of 2½ ins. when compacted.
2. Carefully roll the stone which has been spread, so as to get an even contour and obtain the greatest possible mechanical bond.
3. Apply asphaltic cement by either the hand pouring or pressure distributor method, using from 1¾ to 2¼ gals. per square yard. The asphaltic cement should be applied uniformly and is heated to between 275 and 350 deg. Fahr., so that it will penetrate thoroughly the entire depth of the wearing surface.
4. Spread clean ¾-in. stone over the entire surface immediately after the application of the asphalt. These stone chips should be dry and free from dust.
5. Roll the entire surface until it is solid.



WARD PARKWAY, KANSAS CITY, MO., SHOWING HOW A TEXACO ASPHALT MACADAM PAVEMENT WAS USED TO PROVIDE AN ATTRACTIVE THOROUGHFARE IN A RESIDENTIAL DISTRICT

6. Remove all loose and surplus mineral matter.

7. Make the second application of asphaltic cement in the same manner as the first application. The same grade of asphalt is used but the quantity is less, using from ¼ to ½ gal. per square yard in the second coat.

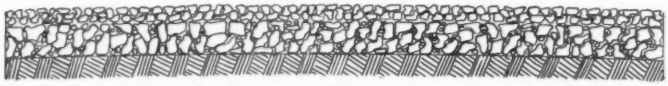
8. Spread ¾-in. stone chips and then roll thoroughly.

The Penetration Method

The above described manner of constructing asphalt macadam roads is called the penetration method. This method gets its name from the fact that the asphaltic cement penetrates and coats the layers of broken stone after they have been placed in the road. The asphalt serves as an adhesive and binding medium in forming the surface.

There are two methods of building asphalt macadam pavements by the penetration method. They are the hand pouring method and the pressure distributor method. Both accomplish the same purpose, only in one the asphaltic cement is applied by hand from pouring cans and in the other the asphaltic cement is applied under pressure by an automobile distributor.

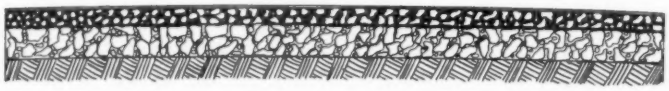
Foundation Which May Be of Gravel or Broken Stone.



Large Stone for Wearing Surface Spread and Rolled Over Foundation. The Size of This Stone is From 1 to 2½ ins., and is Consolidated to a Minimum Depth of 2½ ins.

Large Stone for Wearing Surface After Application of Asphaltic Cement. Amount of Asphaltic Cement is from 1¾ to 2¼ Gals. per Sq. Yd.

Wearing Surface After ¾-in. Stone Has Been Spread and Consolidated by Rolling.



After Application of Seal Coat of Asphaltic Cement. Amount of Asphaltic Cement Applied is from ¼ to ½ Gal. per Sq. Yd.

After Covering Material Has Been Spread Over Seal Coat and Then Rolled.

STEPS IN THE CONSTRUCTION OF A TEXACO ASPHALT PAVEMENT.

TYPES OF PAVED RAILROAD CROSSINGS ON WAYNE COUNTY, MICH., HIGHWAYS

By Edward N. Hines, Chairman Board of County Road Commissioners, Wayne County, 312 County Bldg., Detroit, Mich.

Through co-operation with various railroad companies we are gradually improving all the grade crossings with Wayne County roads, said Mr. Hines in addressing the American Road Builders' Association. Wooden crossing planks are so expensive and of such poor quality that the railroads themselves are glad to cooperate in using some material which will last longer.

Grade crossings have been built by us in the past using the following methods:

First Type

Under light traffic railroads, street car

tracks and sidings, we have been digging out under the ties to a depth of 1 ft. below the bottom tie and filling in with a 1-ft. slab of concrete. Then new ties are placed and new deep rails spiked on. The job is completed by pouring concrete between the ties and over the ties to the top of rail joining with our concrete pavement on either side and striking off level with the top of rail. Flange-way is provided either by allowing the car wheels to form their own flange-way or by placing a rail on its side against the inside of the main rail.

Second Type

One railroad has been progressive enough to allow us to experiment with one of its main double-track lines in putting in a pre-molded concrete slab crossing. These slabs are approximately 2 ft. by 6 ft. long, with a depth the same as the depth of rail. We build them at Wayne in our tile yard and haul them out to the crossing and lay them in place of the common plank. If this type of crossing proves to be a success for highway traffic it will be very desirable, because it is possible for the section crew of the railroad to remove the slab, ballast up the tracks and replace it.

Third Type

The third type of crossing which we have used has been the same as the first, except that the surface has been filled in with special granite blocks along the inner side of the rail, which provides a flange-way.

We have also started on a program of grade separation on important trunk-line roads, and three projects are under consideration at the present time.

TRADE NOTES

Actuated by a desire to assist flood-stricken Pueblo, the Pawling & Harnischfeger Co. has shipped, by special through train, a No. 206 Corduroy Traction Type Excavator-Crane, to the Mayor of Pueblo. This, they believe, will be of service in clearing up the debris, handling materials and for many other purposes.

The plant of the Heltzel Steel Form & Iron Company, Warren, Ohio, was partly destroyed by fire Thursday, June 2. The company, in addition to being manufacturers of steel forms for concrete road, sidewalk, curb and gutter and other concrete construction, are fabricators of general plate construction. The steel fabricating department suffered mostly from the damage—shipments of steel forms having been made a short time after the fire. This department has continued operation almost uninterruptedly since the fire. Because of the present road building campaign throughout the country the steel form department of this company was very busy at the time of the fire, and they are indeed fortunate that this department was not damaged to a great extent. Immediate steps have been taken to get the steel plate fabricating department back into operation, and it is expected within a few days wheels will be turning in this department.

NEW MINNESOTA LAW ON FORCE ACCOUNT WORK

To the Editor:

I have just read with interest your editorial, "For Force Account Work to Learn Costs," in your April number, and I heartily agree with it, except that I believe you should have gone farther and stated that public officials, in carrying out force account work, should see that all costs are charged to the work. Most municipalities doing their own work make no charge for overhead and the use and repairing of outfit.

The State of Minnesota, at the last session of the Legislature, passed a law compelling municipal officials, when contemplating new construction, first to publish an estimate of the cost, and, while the work is under construction, to keep an accurate cost of it, and at the completion of the work publish the total cost. I believe if this law is faithfully carried out it will result in the taxpayers knowing how their money is actually expended.

Very truly yours,

R. A. SCHAFFNER, Chm. Publicity Comm.,
Northwestern Association of General Contractors.

Guardian Life Bldg., St. Paul, Minn., April 29, 1921.

USE OF LABOR SAVING EQUIPMENT ON MUNICIPAL AND COUNTY WORK

In the extensive construction programs now being developed by cities, counties and states, excellent use is being made of labor saving equipment.

The handling of concrete work on the $20,000,000 New York County Court House illustrates the efficient manner in which a Smith 1-yd. Tilting Mixer was used for pouring the substructure. This substructure alone represents a $2,000,000 expendi-

ture for New York County. Careful selection, combination and installation of standard high class machinery so as to insure speedy and reliable completion of the work with minimum hand labor, was the problem studied out and efficiently solved by the engineers and contractors.

The mixer was installed about 10 ft. above the surface in the base of a wooden tower 35 ft. high, surmounted by a 10 yd. and a 20 yd. storage bin for sand and broken stone. The mixer discharges its mixed concrete directly into a 1 yd. quick-shift bucket hoisted in an Insley steel 160 ft. tower. Clever arrangement of the chuting system gives a complete working radius of 210 ft. from the center of the building.

This single mixer produced at the rate of 470 yds. a day with a very small crew. The problem here was a difficult one but it was efficiently solved by modern machinery. It is particularly noteworthy that one mixer only was used on this big $2,000,000 foundation. This suggests that the use of efficient speedy machinery pays well in results attained.

Extensive sewerage work is being proceeded with by the city of Minneapolis. A Smith ½-yd. non-tilting mixer is being used on this work. Milwaukee is completing its sewage disposal system using Smith Tilting Mixers on the concreting of all its tunnels, etc.

The city of Detroit is doing considerable street paving and has added to its battery of pavers, one of the new 14-E Smith paving mixers, steam driven.

Los Angeles County, California, is building its own concrete roads and has just purchased a new 14-E Smith paving mixer, equipped with gasoline motor.

State work on roads is being done in many states by Smith paving mixers, the most popular size being the 21-E, with swivel chute delivery, multipedal traction, gasoline motor and the new Smith ball-bearing derrick.

Extensive use, by counties, is being made this year of the Smith excavator and loader in conection with road work. In Minnesota, St. Louis County, LeSeuer County and Freeborn County are using this unique machine with excellent results for cut-and-fill work, grading, excavating and loading gravel at their gravel pits, etc.

The County Commissioners of Beadle County, S. D., have just purchased one of these machines for similar work. Green Lake County, Wisconsin, has purchased two Smith excavators in the last month, for use in their gravel pits. Sheboygan County, Calumet County and Green County, Wisconsin, are all using the Smith excavator in connection with their road maintenance work and new construction.

An idea of the saving the county, city or state, can effect by the use of modern machinery is indicated in a letter from a user of a Smith excavator, who says: "The machine and two men take the place of 15 laborers, 1 foreman and 3 snatch teams. We now load 3 yds. to a wagon. Formerly we could not average 2 cu. yds. while making a 9 ft. excavation (Note: The Smith excavator and loader works at street level—not in the hole—loads at street level, so no snatch teams are required and heavier loads can be hauled). The excavator handles between 300 and 350 yds. per day. We have loaded 48 cu. yds.—wagon measurement—in one hour. The saving of horses each day would more than equal the cost of operating the machine."

SUGGESTED COMPOSITE STANDARD SPECIFICATIONS FOR EXTERIOR WOOD BLOCK PAVING

By S. M. Feinberg, C. E., Public Works Office, Building No. 13, U. S. Navy Yard, Brooklyn, N. Y.

I was very much pleased to read some of the articles on roadway work published in Municipal and County Engineering, especially the article on wood block pavements written by Mr. Herman von Shrenk in your issue of November, 1920, inasmuch as I am also engaged in the investigation of the problem of laying wood block pavements on bituminous cushions. The bituminous cushion idea is comparatively a new development and very little has been written on it in the engineering periodicals. Therefore, after a thorough study, using all available government information at my disposal, I drew up specifications covering the problem and sent a rough draft for comment and criticism to the principal promoters of wood blocks and coal-tar and asphalt.

The following specifications are a revised and corrected edition of the original rough draft, based on the constructive criticisms of a number of competent men, and are up-to-date, both in regard to materials used and methods of construction.

Inasmuch as the present season will see an appreciable amount of pavement construction, I hope the specifications as presented may prove timely and sufficiently

adequate to be published in the columns of the Municipal and County Engineering.

Especial credit is to be given to the following parties who were kind enough to assist the writer in compiling the specifications:

(1) Philip P. Sharples, Manager, General Tarvia Dept., The Barrett Co.

(2) R. R. Barrett, Engineer, The Texas Co.

(3) J. E. Morris, Manager, Street & Road Dept., and C. N. Forrest, Manager, Technical Dept., The Barber Asphalt Paving Co.

(4) Prevost Hubbard, Chemical Engineer, The Asphalt Association,

(5) F. P. Allen, Manager Road Oil and Asphalt Department, The Standard Oil Co. (Ind.).

(6) H. S. Rinker, C. E., Expert Aide, U. S. Navy Yard, Brooklyn, N. Y.

(7) Lambert T. Ericson, Chief Engineer, the Jennison-Wright Co.

Likewise credit is due to Messrs. Herman von Schrenk, Consulting Timber Engineer, and W. W. Horner, Chief Engineer of Sewers and Paving, St. Louis, Mo., whose suggestions, published in the November, 1920, issue of this magazine, were adopted.

General.

1. *Scope of Work.* Work required includes the provision of all implements, machinery, equipment, tools, materials, and labor necessary for the proper installation of all wood block paving, in accordance with the drawings, this specification and intent thereof, and when completed, the work shall be left in a neat and finished condition.

2. *Materials and Workmanship.* All materials and workmanship shall be of the best quality of their respective kinds, unless other grades are specifically mentioned, and the acceptance of same is understood and agreed to be subject to approval of the engineer in charge.

3. *Samples Required of Contractor Before Work is Begun.* The contractor shall submit to the engineer in charge, for approval, samples of wood block, Portland cement, sand, bituminous materials, and such other samples of materials as may be required, whether specifically called for or not. Accepted samples may be used in the finished work. Materials shall conform to samples. The approval or acceptance of such samples shall not preclude the rejection of any material upon the discovery of defects previous to the acceptance of the completed work.

4. *Loading and Unloading.* All blocks shall be loaded and unloaded with care. They shall not be thrown from cars into wagons, dumped from wagons, nor shall they be piled in any location where they would likely become bespattered, covered with mud, or otherwise injured.

5. *Warranty.* The contractor shall warrant the entire work to be free from defects of workmanship or materials for a period of one year from date of acceptance. He shall furnish a written warranty, satisfactory to the engineer in charge, that he will make good at his own cost and expense any defects developing during that period.

Timber.

6. *Kind.* The wood from which the blocks are to be manufactured shall be thoroughly air seasoned, dry, Southern yellow pine.

7. *Quality.* The blocks shall be sound, well manufactured, square butted, square edged, free from unsound, loose or hollow knots, knot holes and other defects such as shakes, checks, etc., that would be detrimental to the life of the blocks, or interfere with the proper laying of same.

The number of annual rings in the inch which begins 2 ins. from the pith of the block shall not be less than six, measured radially, provided, however, that blocks containing between five and six rings in this inch shall be accepted if they contain 33 1/3% or more summerwood. In case the block does not contain the pith, the inch to be used shall begin 1 in. away from the ring which is nearest to the heart of the block. The blocks in each charge shall contain an average of at least 50% of heartwood. No one block shall be accepted that contains less than 25% of heartwood.

8. *Size of Blocks.* The blocks shall be from 5 to 10 ins. long, 3 and 3½ ins. in depth, for bituminous and non-bituminous cushions respectively, with the grain or fibre of the wood running in the direction of the depth. They shall be from 3 to 4 ins. in width, but in any one city block, they shall be of uniform width. A variation of 1/16 in. in depth, and ⅛ in. in width from the dimensions specified will be allowed.

9. *Lug Blocks.* In case lug wood blocks are used, they shall have two "V"-shaped lugs on the side of the block and one "V"-shaped lug on the end of the block. The lugs shall extend the full depth of the block and shall be an integral part of the block. The lugs shall extend outward from the block either ⅛ in. or 3/16 in. at the option of the engineer in charge, and shall be approximately ¼ in. in width at the base where they join onto

the block. The lugs on the side of the block shall be spaced approximately 5 ins. apart, center to center of lugs, or approximately 2½ ins. from center of the block, measured lengthwise. The lug on the end of the block shall be placed in the center of the block. The grain or fibre of the lug shall run in the same direction as the grain or fibre of the block.

Preservative.

10. *Kind.* The preservative to be used may be either a coal-tar paving oil "A", or a coal-tar distillate oil "B" as specified hereinbelow.

All tests for the preservative used shall be made in strict accordance with the Standard Methods of the American Wood Preservative Association.

11. *"A" Coal-Tar Creosote Paving Oil.* This oil shall be a coal-tar product of which at least 65% shall be distillate of coal gas tar or coke oven tar, and the remainder shall be refined or filtered coal gas tar or coke oven tar. It shall comply with the following requirements:

It shall not contain more than 3% of water.

It shall not contain more than 3% of matter insoluble in benzol.

The specific gravity of the oil at 38 deg. C., compared with water at 15.5 deg. C., shall not be less than 1.07 nor more than 1.14.

The distillates based on water free oil shall be within the following limits:

Up to 210 deg. C., not more than 5%.

Up to 235 deg. C., not more than 25%.

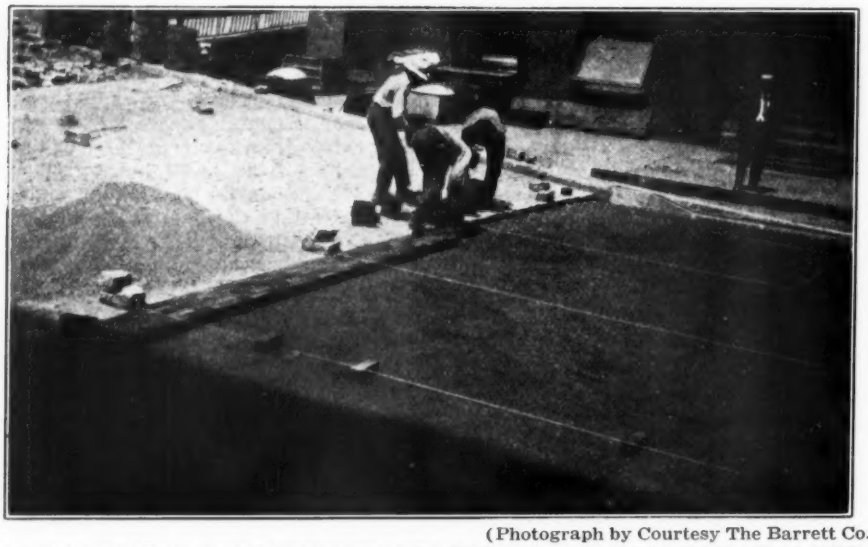
The residue above 355 deg. C., if it exceeds 35% shall have a float test of not more than 80 sec. at 70 deg. C.

The specific gravity of the fraction between 235 deg. and 315 C. shall not be less than 1.03 at 38 deg. C., compared with water at 15.5 deg. C.

The specific gravity of the fraction between 315 deg. and 355 deg. C., shall not be less than 1.10 at 38 deg. C., compared with water at 15.5 deg. C.

The oil shall not yield more than 10% of coke residue.

12. *"B" Coal-Tar Creosote Paving Oil.* This oil shall be a distillate of coal gas tar or coke oven tar and shall comply with the following requirements:



(Photograph by Courtesy The Barrett Co.)

LAYING WOOD BLOCK PAVEMENT OVER TAR-SAND CUSHION ON EAST WATER ST., SYRACUSE, N. Y.

It shall not contain more than 3% of water.

It shall not contain more than 0.5% of matter insoluble in benzol.

The specific gravity of the oil at 38 deg. C., compared with water at 15.5 deg. C., shall not be less than 1.06.

The distillates based on water free oil shall be within the following limits:

Up to 210 deg. C., not more than 5%.

Up to 235 deg. C., not more than 15%.

The residue above 355 deg. C., if it exceeds 10% shall have a float test of not more than 50 sec. at 70 deg. C.

The specific gravity of the fraction between 235 deg. C. and 315 deg. C. shall not be less than 1.03 at 38 deg. C., compared with water at 15.5 deg. C.

The specific gravity of the fraction between 315 deg. C. and 355 deg. C. shall

not be less than 1.10 at 38 deg. C., compared with water at 15.5 deg. C.

The oil shall not yield more than 2% of coke residue.

Creosoting.

13. *Method "A."* (Full Cell Process.) The wood blocks after being cut and ready for treatment, shall be placed in a suitable iron receptacle or cylinder and there sterilized with dry steam under a pressure of not less than 30 lbs., and not more than 50 lbs. per square inch for not less than three hours and as much longer, not to exceed seven hours, as the condition of the wood may require. The temperature within the cylinder during the process of steaming shall be between 250 and 280 deg. F. At intervals during this process the condensed steam, sap, and other liquid matter shall be drawn from the receptacle by means of valves. At the completion of the steaming process all condensed steam and other fluid matter shall be blown from the cylinder through an opening in its bottom and all the steam shall be caused to pass out through an opening in its top.

The drain and exhaust valves of the cylinder shall then be closed and a vacuum pump shall produce a vacuum of at least 24 ins., and as much more as may be necessary, as quickly as possible. The vacuum shall be maintained in the cylinder until the moisture and gases cease to escape therefrom. During this process the wood blocks within the cylinder shall be kept hot by means of steam coils.

Immediately thereafter, and while the vacuum still exists, creosote oil, having a temperature between 180 and 200 deg. F. shall be run into the cylinder and such pressure maintained that the wood blocks shall be impregnated with creosote oil to the amount of not less than 12 lbs. of creosote oil per cubic foot of timber. The excess of creosote oil in the cylinder shall then be withdrawn and the blocks drained and prepared for shipment.

14. *Method "B."* (Empty Cell Process.) The blocks shall be placed in an air-tight cylinder and subjected to an initial air pressure of not less than 40 lbs. nor more than 80 lbs. per square inch, depending upon the seasoned condition of the timber to be treated, until all the cells and cavities of the wood are filled with air.

While the initial air pressure is maintained, the creosote oil at a temperature of not less than 150 deg. F. shall be introduced into the cylinder at a still higher pressure. As the creosote oil is being forced into the cylinder, air shall be allowed to escape into an auxiliary air chamber through a valve located at the highest point of the cylinder in order to completely fill the cylinder with the hot creosote oil without reducing the initial pressure.

As soon as the blocks are completely covered and the cylinder entirely filled with the hot creosote oil, the initial pressure shall be gradually increased by forcing in additional quantities of creosote oil, until a maximum quantity of oil has been injected, under a total pressure of about 150 lbs. per square inch. The creosote oil shall be maintained at a temperature of not less than 150 deg. F. during the entire pressure period within the cylinder. In this way as much oil shall be forced into the timber as it is possible to inject under safe temperature and pressure.

The pressure shall then be cut off and the creosote oil discharged from the cylinder.

A vacuum of about 20 ins. shall then be applied after which the hot creosote oil shall again be allowed to fill the cylinder.

Hydraulic pressure of not less than 100 lbs. per square inch shall then be applied and maintained until a total quantity of not less than 12 lbs. of creosote oil per cubic foot of timber has been forced into the blocks. The temperature of the oil within the cylinder during this period shall be maintained at not less than 150 deg. F.

The pressure shall then be cut off and the creosote oil discharged from the cylinder.

Cushion Materials.

15. *Coal-Tar Pitch.* The pitch used for pitch paint coat, as described hereinafter, shall be a straight run residue obtained from the distillation of coal tar, and shall comply with the following requirements:

The melting point, determined by the American Society for Testing Materials Tentative Method, shall not be lower than 140 deg. F., nor higher than 150 deg. F.

It shall contain free carbon not less than 18% nor more than 37%, insoluble in hot chloroform and benzol.

The specific gravity at 77 deg. F., shall not be less than 1.22 nor more than 1.34.

The specific gravity of the distillate up to 355 deg. C., shall not be less than 1.07 at 38 deg. C., compared with water at 15.5 deg. C.

When 100 g. are distilled at 670 deg. F., by the A. S. T. M. method, using a 250 c.c. Engler Flask, the specific gravity of

the distillate shall not be less than 1.07 at 100 deg. F.

The pitch shall be heated to a temperature not exceeding 325 deg. F., and shall be poured at a temperature between 250 deg. and 300 deg. F.

16. *Asphaltic Cement.* The asphaltic cement, used for asphalt sand mastic cushion, as described hereinafter, shall comply with the following requirements:

It shall be thoroughly homogeneous, free from water and shall not foam when heated to 350 deg. F.

It shall have a penetration at 77 deg. F. of from 50 to 60.

It shall not flash below 350 deg. F.

When 50 grams of the asphalt cement are heated for five hours at 325 deg. F., in a tin box 2¼ ins. in diameter and 1½ ins. deep, the loss shall not exceed 3% by weight of the penetration at 77 deg. F., and the residue left after such heating must not be less than the penetration at 77 deg. F. of the original sample before heating.

When the asphalt cement is made into a briquette (Dow Mound) it shall have a ductility of not less than 30 cms. at 77 deg. F.; the two ends of the briquette to be pulled apart at the uniform rate of 5 cms. per minute.

17. *Tar.* Tar for tar sand cushion, as described hereinafter, shall conform to the following requirements:

The specific gravity shall not be less than 1.14 nor more than 1.18 at 60 deg. F. (15.5 deg. C.).

The viscosity tested by the Standard Engler Viscosimeter shall not be more than 250 sec. nor less than 100 sec. for 100 c.c. at 104 deg. F. (40 deg. C.).

On distilling 100 c.c. of the material to 338 deg. F. (170 deg. C.), not more than 7% shall distill over. On continuing the distillation to 572 deg. F. (300 deg. C.) the residue shall be not less than 65 grams. This residue shall be a soft pitch at 60 deg. F. (15.5 deg. C.). If the residue appears hard, it shall be tested for melting point and the melting point shall not exceed 140 deg. F. (60 deg. C.) by the ½-in. cube method in water. The specific gravity of the entire distillate shall be not less than 1.01 at 60 deg. F. (15.5 deg. C.).

The free carbon shall be not less than 4% nor more than 12%.

In making the foregoing tests, the following methods shall be employed:

(a) Specific gravity. The specific gravity shall be determined by the use of a Hubbard type specific gravity bottle. The bottle shall be filled with the liquid material at a convenient temperature. The bottle shall then be kept in a water bath at 60 deg. F. (15.5 deg. C.), until the level of the liquid, after adjustment to the mark, shows no further contraction. The bottle shall then be weighed. The weight of the material, divided by the weight of the same volume of freshly boiled distilled water at 60 deg. F. (15.5 deg. C.) is the specific gravity.

(b) Distillation. A 250 c.c. Engler flask shall be used and 100 c.c. of the material taken for distillation. The apparatus shall be set up and the distillation conducted as provided for in the tentative method proposed by the American Society for Testing Materials.

The distillate shall be collected in weighed flasks and fractions shall be determined by weight.

Receivers shall be changed when the thermometer records a temperature of 338 deg. F. (170 deg. C.). When the thermometer records a temperature of 572 deg. F. (300 deg. C.) the flame shall be removed.

(c) Melting Point. A clean shaped ½-in. cube of the material shall be formed in the mould, placed on a hook of No. 12 (B&S guage) copper wire and suspended in a 600 c.c. beaker so that the bottom of the cube shall be 1 in. above the bottom of the beaker (a sheet of paper placed on the bottom of the beaker, and conveniently weighted, will prevent the pitch from sticking to the beaker when it drops off). The cube shall remain five minutes in 400 c.c. of freshly distilled water kept at a temperature of 40 deg. F. (4.5 deg. C.) before heat is applied. Heat shall be applied in such manner that the temperature of the water shall be raised 9 deg. F. (5 deg. C.) each minute. The temperature recorded by the thermometer at the instant the material touches the bottom of the beaker shall be the melting point.

(d) Free Carbon. The free carbon shall be determined by making a hot extraction of five to ten grams of material with C.P. Toluol followed by C.P. Benzol, or C.P. Benzol followed by chloroform as solvents. The extraction shall be made in a Soxhlet, Knorr Underwriters, or some other suitable extraction apparatus. The distillation of the solvent shall be continued until the washings run through practically colorless.

(e) Viscosity. The viscosity shall be determined in a standard Engler Viscosimeter at 104 deg. F. (40 deg. C.). Sufficient material shall be placed in the vis-

cosimeter to bring the surface of the liquid to a level with the tops of the three levelling points. The time required to discharge 100 c.c. shall be recorded as the viscosity.

18. *Cement Sand Cushion.* The cement sand cushion shall be composed of 1 part of Portland cement and 4 parts of sand, meeting the following requirements:

(a) Portland Cement. All cement used in this work shall be Portland Cement, which shall conform to the latest standard specifications for Portland Cement adopted by the American Society for Testing Materials.

(b) Sand. The sand shall consist of hard, durable grains, absolutely free from stones or pebbles and free from vegetable and other deleterious substances. When dry it shall pass a ¼-in. laboratory screen and shall be well graded from coarse to fine. The material removed by the elutriation test, consisting chiefly of clay and loam, shall not exceed 5% by weight.

Filler Materials.

19. *Coal-Tar Pitch Filler.* The coal-tar pitch for filler shall be a coal-tar pitch as specified in paragraph No. 15.

20. *Asphalt Filler.* This filler, if used, shall be a bituminous material conforming to the following requirements:

It shall be homogeneous, free from water, and shall not foam when heated to 200 deg. C. (392 deg. F.).

Specific gravity at 25 deg./25 deg. C. (77 deg./77 deg. F.) shall be not less than 0.980.

Flash point shall be not less than 200 deg. C. (392 deg. F.).

Melting point shall be not less than 78 deg. C. (172 deg. F.).

Penetration at 25 deg. C. (77 deg. F.) 100 g., 5 sec. shall be from 30 to 50.

Penetration at 0 deg. C. (32 deg. F.) 200 g., 1 min., shall be from 10 to 20.

Penetration at 46.1 deg. C. (115 deg. F.) 50 g., 5 sec. shall be from 150 to 300.

When 50 grams are heated in an open tin to a temperature of 325 deg. F., for 5 hours, the loss shall not exceed 1 per cent, and the penetration at 77 deg. F. of the residue left after such heating shall not be less than two-thirds of the penetration of the original material before such heating, when tested at 77 deg. F.

Total bitumen (soluble in carbon disulphide) shall be not less than 95 per cent.

It shall show a ductility of not less than 30 centimeters when tested at 77 deg. F.

21. *Asphaltic Cement.* The asphaltic cement used for asphalt sand mastic filler shall be the same as specified in paragraph 16.

Construction.

22. *Subgrade.* The bottom of excavation and the top of fill shall be true to the lines, grades, and cross-sections given for the subgrade. After all drains have been laid and the subgrade has been shaped correctly, it shall be brought to a firm unyielding surface by rolling the entire area with a 10-ton roller. Any portion of the subgrade which is not accessible to a roller shall be compacted thoroughly with hand tampers, weighing not less than 50 lbs., the face of which shall not exceed 100 sq. ins. All soft and yielding material, and other portions of the subgrade which will not compact readily when rolled or tamped, shall be removed and all loose rock or boulders found in the excavation shall be removed or broken off to a depth of not less than 6 ins. below the surface of the subgrade. All holes or depressions so made shall be filled with suitable material and the whole surface shall be compacted uniformly. If settlement occurs or in case an old stone or gravel roadbed is encountered, the depressions and all loose portions of the roadbed shall be scarified, filled and rerolled until the surface is solid, uniform, and parallel with the required grade. In excavating, the ground shall not be plowed or disturbed below the surface of the subgrade, except as otherwise specified herein.

23. *Base Course.* All materials for and the construction of base courses, including all necessary drainage during construction, clearing, grubbing and all excavation for sub-base work, as specified hereinabove, shall be performed in strict accordance with the cross-sections and in the best possible manner for this type of construction.

The concrete base course, 6 ins. thick in its least depth, shall be composed of 1:3:5 and 1:3:6 mixture for bituminous and non-bituminous cushions respectively, and it shall be laid on a thoroughly compacted sub-base.

The crown of any base course shall not be less than ¼ in. nor more than ⅜ in. per foot of width.

If bituminous cushion is used, the surface shall be finished in one operation by means of a long-handled wooden float

provided with up-turned ends in order to prevent ridging; the surface when finished shall be such, that when tested with a metal-shod straight-edge 5 ft. long, laid upon it in a direction parallel to the curb, it shall show no departure from this straight-edge greater than ¼ in. Projections greater than ¼ in. shall be trimmed down and all depressions shall be flushed even with a mortar consisting of 1 part of cement to 3 parts of sand.

If non-bituminous cushion is used, the base course shall be finished by screening with a template arranged to give the proper grade and crown; the surface when finished shall be such, that at no point it shall be above the theoretical finished surface. Depressions of small area, not more than ½ in. below this theoretical grade and not general in extent or occurrence, will be permitted and no attempt will be required to fill them to the general grade after the slab has set.

24. *Pitch Cushion.* (Pitch Paint Coat.) After the base course has hardened and is thoroughly dry, it shall be covered with a coat of pitch, as specified, under the heading for "Cushion Materials," not more than ⅛ in. in thickness. The pitch shall be applied at a temperature of not less than 250 nor greater than 300 deg. F., and it shall be allowed to cool and harden up before laying the blocks.

25. *Tar-Sand Cushion.* Tar-sand cushion composed of approximately 10% tar, as specified under the heading for "Cushion Materials," and 90% dry, clean sand shall be mixed cold and dumped on the base course. After raking, the mixture shall be spread uniformly over the base, without rolling, and after tamping to a thickness not less than ¾ in. nor more than 1½ in; the mixture shall remain uncovered for a period of not less than 24 hours, and then the blocks shall be laid thereon.

26. *Asphalt Sand Cushion.* Asphalt sand cushion shall consist of a mixture of asphaltic cement as specified in paragraph No. 16, and hot dry sand or hot dry stone chips mixed in the following proportions: asphaltic cement, 5 to 7% and stone or stone chips 93 to 95%. Not more than 3% of the sand or stone chips shall pass a screen having 200 meshes to the inch, and all shall pass a screen having 10 meshes to the inch. The aggregate shall be proportioned from fine to coarse so as to produce a minimum of voids.

The sand and asphaltic cement shall be heated in separate heaters to a temperature of not less than 325 deg. F., nor more than 350 deg. F. The asphalt heating kettle shall be properly equipped with an approved agitating device and thermometer so that the asphalt may be properly heated without injury to the material. The sand and asphalt or stone chips and asphalt shall be mixed thoroughly either in an approved hot mechanical mixer or in a concrete push car. The sand or stone chips and the asphalt shall be thoroughly mixed so that each particle of sand or stone chips shall be completely coated with the asphaltic cement until the whole mass is of a homogeneous consistency.

After the material has been thoroughly mixed it shall be immediately spread upon the base course, which shall be absolutely clean and dry, to an average thickness of not less than 3 nor more than 4 ins. The mixture shall be spread with hot rakes and brought to the proper contour, after which it shall be immediately rolled with a hand roller, weighing not less than 25 lbs. per inch width of wheel base. The surface of the roller shall be kept lightly oiled in order to prevent picking up the cushion.

After the cushion has been thoroughly shaped and compressed by means of the hot rakes and roller, the blocks shall be set while the cushion is still hot.

27. *Cement Sand Cushion.* Upon the prepared base course, which shall be cleared of all loose and foreign materials and dampened thoroughly, there shall be spread a mixture of 1:4 cement and dry sand to form a bed for the blocks, to a thickness of not less than ½ in. The cement and sand shall be mixed dry, to a uniform color, in an approved batch mixer, or if by hand, on a clean, tight surface. The cushion shall then be shaped carefully by means of an approved templet and the entire surface of the bed shall be rolled with a hand roller, which shall not be less than 36 ins. in diameter, 24 ins. in width, shall weigh not less than 10 lbs. per inch of width, and shall have a handle not less than 12 ft. in length. The rolled cushion shall be sprinkled, immediately in advance of the block laying, with hand sprinklers or hose with a spray nozzle. No more cement-sand shall be mixed or prepared than can be used within any continuous working period, and any bed upon which the blocks are not laid and rolled, during any continuous working period, shall be removed and replaced with fresh materials when work is resumed. Cement-sand cushion which is injured or dis-

placed by flow of water, rain, or by any other cause, shall be replaced with new material, to the full satisfaction of the engineer in charge. The workmen shall not walk upon the cushion after it has been shaped with the templet.

28. *Laying Blocks.* All blocks shall be laid carefully with the best face up, from one side of the pavement to the other side, in parallel straight courses at right angles to the center line, except at intersections and on curves where they shall be laid as directed by the engineer in charge. The blocks shall be laid with both ends and sides in contact, breaking joints not less than 2½ ins. The courses shall be straightened by striking lightly with a sledge on a 4 by 4-in. timber 3 ft. long, placed against every eighth course, all thick blocks being removed. At the ends, and where necessary between courses, closures shall be made by carefully placing blocks cut accurately to give close joints.

Cut or broken blocks shall be used only at the ends of courses placed with the cut end turned towards the adjacent whole block; the cut or broken blocks shall be not less than 3 ins. in length. While laying blocks, the pavers shall not walk or stand on the cushion, all the work of block laying being done over the blocks already laid. Tamping or wheeling upon the cushion will not be permitted. The spaces between the blocks shall be kept clean and open to the bottom until the filler is applied.

In no case shall blocks, chipped to wedge shape, be used except on curves where absolutely necessary and only when permitted by the engineer in charge. After laying, the blocks shall be inspected once more, culled and approved for rolling, all defective blocks being removed and replaced by perfect blocks.

Experienced blocklayers only shall be employed in laying, cutting and trimming blocks.

29. *Corrugated Card-Board Spacers.* In case plain rectangular blocks are used, the contractor may, at his option, use single-faced corrugated card-board spacers, approximately 3/16 in. thick and 1¼ in. deep, extending the full width of the pavement.

30. *Rolling Blocks.* Before rolling, the pavement shall be inspected carefully and all defective blocks culled out after which the surface of the blocks shall be swept clean. The pavement shall then be rolled with a tandem roller, weighing, unless otherwise specified, not less than 2½, nor more than 5 tons, commencing at the sides and proceeding slowly back and forth, parallel to the sides, until the center of the pavement is reached; then passing to the opposite side, the rolling shall be repeated in the same manner until the center is again reached, after which the speed may be increased, and the rolling continued until the blocks are bedded firmly. The rolling shall then be done, from one side of the pavement to the other side, at an angle of 45 deg., repeating this operation in the opposite direction. All blocks which are broken or injured during rolling shall be removed and replaced with perfect ones, which likewise shall be brought to the true surface. When a cement-sand bed is used, the surface shall be rolled immediately after laying, so as to complete it before the cushion begins to set. The blocks adjacent to curbing and other areas inaccessible to the roller shall be tamped to grade by the use of a hand tamper, applied upon a 2-in. plank. If the cushion is forced up between the blocks more than ½ in., the blocks shall be removed and the cushion reshaped.

After final rolling the pavement shall be tested with a 10-ft. straight-edge, laid parallel with the side of the pavement, and any depression exceeding ¼ in. shall be corrected, and if necessary, the entire surrounding surface again re-rolled.

31. *Filler.* Coal-tar pitch or asphalt filler, if used, shall be as hereinbefore specified under the heading for "Filler Materials," applied, unless otherwise specified, as described hereinafter for pitch-sand mastic filler.

The coal-tar pitch filler shall be applied at a temperature of not less than 250 deg. F., nor more than 300 deg. F.

The asphalt filler shall be applied at a temperature of not less than 350 deg. F., nor more than 400 deg. F.

32. *Pitch-Sand Mastic Filler.* The pitch-sand mastic filler shall be paving tar pitch as hereinbefore specified under the heading for "Cushion Materials," thoroughly mixed with as much hot, dry sand as the pitch will carry, but in no case shall the volume of the sand exceed the volume of the pitch. The sand shall be fine and clean, all of it passing a 20-mesh screen. It shall be heated to a temperature of not less than 300 deg. F., nor more than 400 deg. F., and shall be between these limits when mixed with the paving tar pitch, heated to not less than 250 deg. F., nor more than 300 deg. F.

The coal-tar pitch shall be heated in kettles, properly equipped with approved thermometers, registering the temperature of the tar pitch.

The mixture shall be flushed on the surface of the blocks and pushed rapidly into the joints while hot with squeegees or other suitable tools, subject to approval of the engineer in charge, reflushing or repouring, if necessary, in the opinion of the engineer in charge, until the joints remain permanently filled to approximately within ½ in. and 1 in. of the surface of the pavement, for non-bituminous and bituminous cushions respectively. All squeegeeing shall be done in one direction, without mopping back and forth and as little of the mixture as possible shall be left on the surface. No sand shall be swept into the joints between the blocks, prior to squeegeeing the mixture, unless so directed by the engineer in charge.

The pitch shall be delivered where directed by the engineer in charge in time to allow for examination and analysis.

In applying the filler, care shall be taken that the blocks are clean and dry, that the pavers are closely followed by the filler gang, and in no case shall the paving be left over night, or when work is stopped, without the filling of the joints being completed. In case rain stops the filler gang before its work is finished, the joints shall be protected by the use of tarpaulins, or other approved means, in order to keep out water. Under no circumstances shall the filler be poured into wet joints.

A top dressing of clean dry sand shall be swept into the unfilled space of the joints immediately after the filler is applied.

33. *Asphalt-Sand Mastic Filler.* Asphalt-sand mastic filler may be used in lieu of tar-pitch-sand mastic filler, as specified hereinbefore, except that in this case, asphaltic cement, as hereinbefore specified under the heading for "Filler Materials," shall be used and the sand shall be heated to not less than 400 deg. F., and the mixture shall be used only when it registers between 350 and 400 deg. F. All filler heated beyond 450 deg. F., will be rejected.

34. *Expansion Joints.* Expansion joints shall be formed along the edges of the pavement, next to curbs, against side walls of buildings and where street car or railroad tracks cross the streets transversely. In case non-bituminous cushion is used, transverse expansion joints, not less than 25 ft. apart shall be provided and installed. The joints shall be ½ in. in width, unless directed otherwise, and they shall be formed by placing together on edge two wedge-shaped wood strips 4 ins. in depth and each strip dressed on both faces. The strips shall be so cut that when placed in reverse positions, their total section shall be rectangular and of a thickness equal to the thickness of the required joint. The strip placed next to the pavement shall be set with the narrow edge up and the other one in the reverse position. These strips shall break joints and they shall be set true to grade with ends tight, the bottom pressed into the bed and the blocks laid lightly against them.

The wood strips shall be installed before the blocks are laid and the back one loosened up as soon as filling is started.

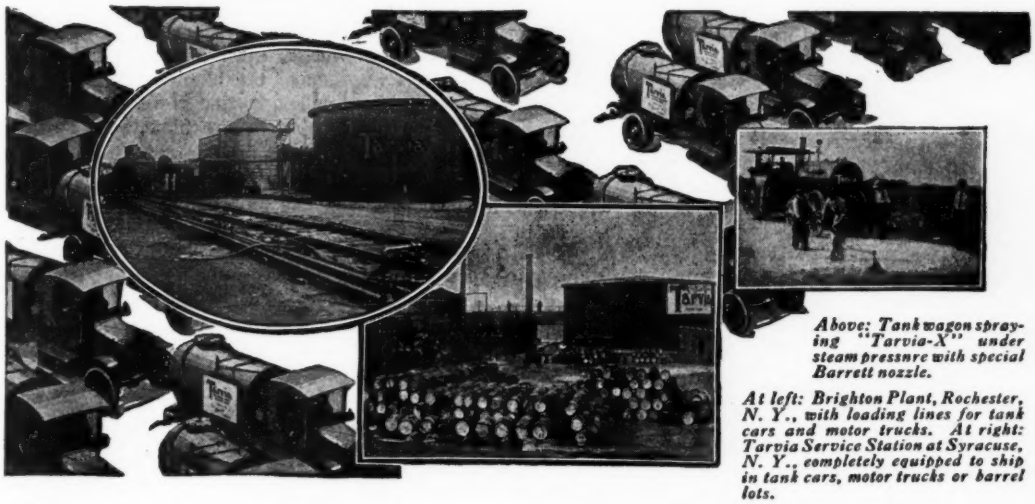
Care shall be exercised to make the joint uniform in width and not ragged.

Soon after the filler has been squeegeed into the interstices of the pavement, the expansion joint strips shall be removed carefully so as not to disturb the blocks or break the bond of the filler, the joints shall be cleaned thoroughly to their full depth and then they shall be poured full, immediately, with a hot bituminous filler. These joints shall be repoured when necessary in the opinion of the engineer in charge.

In case premolded strips of fiber matrix and bitumen or similar material of approved quality are used, the bitumen shall be heated from 225 deg. to 250 deg. F., at the time of its application. The joint material swabbed with hot bitumen on top shall extend through the entire thickness of the pavement. Care shall be observed in order to prevent the bitumen from spreading over the surface of the pavement for a width of more than 1 in. on either side of the joints. All joints shall be covered with clean, sharp sand before the pavement is opened to traffic.

35. *Blocks on Grades.* When the blocks are laid on grades of 4% or over, it is desirable that the method of separation for open joints on the sides of the block provide for a spacing between each course of 5/16 in.

36. *Curbs.* The curbs, where indicated, shall be constructed of 1:2:4 concrete, 18 ins. deep, 6 ins. wide on top and 10 ins. wide at the bottom. All curbs shall be built to the established grade in a continuous line, parallel with the center line of streets except at all intersections of streets and offsets to buildings, where curbs shall be rounded to such a radius



Above: Tank wagon spraying "Tarvia-X" under steam pressure with special Barrett nozzle.

At left: Brighton Plant, Rochester, N. Y., with loading lines for tank cars and motor trucks. At right: Tarvia Service Station at Syracuse, N. Y., completely equipped to ship in tank cars, motor trucks or barrel lots.

Service!

CALL on our Special Service Department regarding your road problems or the conditions in your vicinity. We gladly put the skill and experience of our engineers at your disposal. This service is free for the asking. If you are interested in *better roads* and *lower taxes*, here is an organization that can be of real service to you.

Tarvia—*When* you want it

In road work, building or repair, nothing is more important than having material on hand *when* it is wanted. Delays and holdups on delivery are expensive. Tarvia Service can be depended upon. Tarvia Service is always "on the job."

Tarvia—*Where* you want it

Back of Tarvia Service stands the great Barrett organization with its branches, placed all over the U. S. These branches are strategically located to afford efficient centers of distribution. You can always get Tarvia *where* you want it.

Tarvia—*How* you want it

Tarvia can be delivered by tank car, motor truck, tank wagon or in barrels. As a rule, Tarvia motor truck service is available within 40 miles of any Barrett Service Station or plant. When the size of the job warrants, motor trucks may be furnished at any distance from the plant or service station, the trucks operating from tank cars placed on sidings.

Motor truck distribution is faster and well worth the slight increase in price necessary to cover the use of the trucks, but equally good results may be obtained with the tank wagon—Barrett nozzle method—as shown in small illustration above.

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Tarvia

Preserves Roads-Prevents Dust

TARVIA is a coal tar preparation made in a number of grades to meet varying road conditions. It is the most popular road material in America and has solved the problem of low cost, traffic-proof roads and pavements for hundreds of towns throughout the country.

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as the engineer in charge may direct. The top and inside surface of curbs shall be given a smooth finish, complete, to the point of each day's work.

37. *Curb Guards.* Headers subjected to transverse traffic shall have steel corner mouldings, of a type subject to approval of the engineer in charge, forming a curved finish on the two exposed angular edges of the curb or header; where the curb is parallel to direction of traffic and above the grade of the roadway, similar steel mouldings shall be used, where indicated, in order to form a curved finish on the angular edge nearest to the roadway. The outer exposed edge may have a curved finish on the concrete, corresponding to that of the steel corner moulding used at the inner edge.

38. *Miscellaneous.* Especial attention is invited to construction at existing manholes and catch-basins and at points where railroad or street car tracks cross streets. Manholes and catch-basins shall be raised or lowered if found necessary, in the opinion of the engineer in charge. Where railroad or street car tracks cross streets, expansion joints shall be provided and installed as specified hereinbefore and as indicated.

39. *Protection.* Immediately after the spaces between the blocks have been filled and while the filler is still soft and pliable the pavement shall be covered with a layer of approved clean, coarse sand, not less than ¼ in. thick, which shall be heated if directed by the engineer in charge. No traffic whatsoever shall be permitted on the pavement until the filler has cooled to the air temperature. This covering, kept wet, shall remain on the pavement for such time as may be directed by the engineer in charge, after which it shall be removed in a manner satisfactory to the engineer in charge.

In case cement-sand bed is used, the pavement shall be protected against traffic for a period of time to be established by the engineer in charge.

40. *Inspection.* All materials herein specified and processes used in the manufacture and creosoting of the blocks shall be subject to tests and inspection, acceptance or rejection at the point of manufacture, where there shall be provided all the necessary gauges, appliances and facilities to enable the inspector to satisfy himself that the requirements of the specifications are fulfilled.

Attention is invited to the fact that a perfect penetration of every particle of sapwood is expected and a careful inspection of the blocks, after treatment, by sawing a number of the blocks, taken at random, through the center of the blocks and at right angles to the fibre, will be resorted to.

The purchaser shall have the further right to inspect the blocks after delivery upon the premises for the purpose of rejecting any blocks that do not meet these specifications, except that the plant inspection shall be final with respect to creosote oil and treatment.

41. *Items of Proposal.* Proposals shall be submitted to the engineer in charge upon the following items:

Item I for the use of tar-sand cushion in entire work, complete, in accordance with the drawing and this specification, based on plain wood blocks, coal-tar pitch cushion and either pure bitumen or bituminous sand mastic filler.

Item 2. Amount to be added to the net price stated under Item 1 for the use of lug wood blocks instead of plain wood blocks.

Item 3. Amount to be added to or deducted from the net price stated under Item 1 for the use of tar-sand cushion instead of coal-tar pitch cushion.

Item 4. Amount to be added to or deducted from the net price stated under Item 1 for the use of asphalt-sand cushion instead of coal-tar pitch cushion.

Item 5. Amount to be added to or deducted from the net price stated under Item 1 for the use of cement-sand cushion, instead of coal-tar pitch cushion.

NOTE: The specifications as drawn herein tend to cover average conditions only. Should circumstances warrant, other kinds of wood, such as North Carolina pine, Norway pine, black gum, tamarack, etc., may be used. Likewise, the melting point, penetration, etc., of the bituminous materials used should be modified to meet extreme climatic conditions. Should it become evident from laboratory tests conducted by the engineer that the moisture content in the blocks is higher than anticipated and there is a danger of shrinkage, the preliminary steaming treatment should be decreased, a fine sand filler, approximately ¼ in. in depth should be swept into the joints between the blocks, before the bituminous filler is poured, and the blocks themselves should be driven together as tight as possible, all in order to prevent trouble due to a possibility of shrinkage.

WATER WORKS SECTION

ANNUAL CONVENTION OF THE AMERICAN WATER WORKS ASSOCIATION

The best convention ever held by the American Water Works Association was its 41st annual meeting held June 6-10 in Cleveland, Ohio. Not only was the attendance greater than at any previous meeting, but the program was better balanced this year than ever before. A general feeling of genuine optimism was observed among the delegates and this reflects the improving trend in every aspect of the water supply business.

Papers were presented covering in detail every side of the Cleveland water supply works and their operation, as a preliminary to either group or individual visits by delegates to any desired feature of the works. During the convention the Cleveland Water Department maintained an information bureau at the convention office and provided conveyances to take members to view the works.

Among the more important phases of the water works business which occupied the attention of the convention were the following: Water waste; the cleaning of water mains; water rates; oil engines; meters; water storage; water filtration; water works publicity; construction equipment; the chemistry and bacteriology of water purification, etc. Entire sessions were devoted to some of these topics and a few of the papers presented are published in this issue.

A new feature at this convention was the meeting in small groups, on the first day, of those early in attendance, for the purpose of discussing various practical topics of common interest. Seven topics were chosen and members interested in a certain topic registered for assignment to the desired group. The object of these meetings was social as well as technical. Aside from these group meetings, the first day was devoted to registration and to committee meetings. On the second day the Cleveland works were thoroughly described as previously stated, and at the evening session the Water Works Manufacturers' Association had charge of the meeting and arranged the program. All of the papers at this session were by men engaged in the manufacture or sale of water works supplies. This meeting was an experiment, and a very successful one, and it is probable the producers of materials will be heard again by the users at an annual convention. It certainly is high time the producers were recognized in this way, and we hope they will not, on any occasion, abuse this new privilege by working sales talks into what should be impartial, studious efforts to learn the truth and make it known for the benefit of the water works fraternity.

Beekman C. Little, of Rochester, N. Y., the outgoing president, delivered the presidential address. Mr. Little expressed deep pride in the association and made confident predictions of its increasing usefulness. He urged water works men to let their lights shine so they would be better appreciated by the home folks. His suggestion that philanthropists use water systems in making bequests to humanity is novel and worthy of the notice of those of ample means and generous impulses.

The session on water filtration was devoted to a consideration of filtration from the operator's standpoint. On the fourth day there were two separate programs of papers: one for the superintendent and the other for the chemical and bacteriological section.

Professor Edward Bartow, of the Department of Chemistry at Iowa State University, was elected president of the Association for the coming year. W. S. Cramer, chief engineer for the Lexington Hydraulic & Manufacturing Co., of Lexington, Ky., was elected vice president; W. W. Brush, of New York City, was elected treasurer, and J. M. Diven, also of New York, was re-elected secretary.

The Council on Standardization, which was established by the Association at the Montreal convention in 1920, has been outlining its work by conference and correspondence during the past year. The work of the council is now considered by many, even at this early date, the most important work of the Association, and undoubtedly the report of the council was the outstanding feature of the Cleveland convention. We give herewith the major

report of the council, of which Mr. George W. Fuller is chairman:

"The council has considered it much better to develop a working program which is flexible, yet comprehensive, rather than to have appointed at once a large number of committees without well-defined purposes and with personnel selected without the full consideration desirable. It has been certain from the outset that no program should be laid out which cannot be followed by committees with individual resources at the command of their members, by the help the Association can give, and by the assistance that reasonably can be expected from other sources.

"In general, the committees will find it useful to function in two ways. The first is to carry on actual investigations, which may not furnish much information except at intervals. The second is to prepare for publication in the Journal brief abstracts of the reports and papers on current developments of importance to the members. The publication of such abstracts can be made of high educational value, and their preparation is an excellent way to secure the co-operation of some of the younger members in committee work. It is suggested that the Association should compensate the members who do this work at the rate of about half a cent a word for the abstracts as printed. For some years it is probable that this abstracting of information will be the most productive educational features of the council's work.

"It is expected that each committee will first lay out a program for carrying on the work assigned to it, and will then take up this program with the council. When it has been developed to the satisfaction of the council, the latter will take steps to gain for it the support of the Association. The council believes that 'practical' committee work should be carried along simultaneously with research, so that water works operators will get the maximum possible benefit as early as practicable from the council's activities. Furthermore, this program will make it practicable for each committee to carry its work forward in the speediest way to the point where the experience of the practical water works men can be drawn upon in order to couple theory and practice in the most helpful way. In this manner a large number of our members will be joining co-operatively in improving water works practice.

"The council has held conferences at Cleveland and has reached the conclusion that the committee work outlined should be undertaken. In order to carry it on properly, the council has asked the Finance Committee to place $2,000 to its credit in the 1921-1922 budget.

"The council regards itself as a Committee on Committees for those subjects which involve standardization matters. It will be the committees and not the council which shall be given credit for actual performances, while to the council will fall the task of co-ordinating and stimulating action along practical lines and of avoiding duplication of effort. It is not to be expected that each committee will produce, year by year, reports of great importance, but it is hoped that all committees will put before the membership concrete statements of progress made in their respective fields, expressed in such a manner as to be readily understood by those interested in a practical way in these subjects.

"To get the abstracts under way a committee consisting of A. L. Fales, J. N. Chester, F. C. Jordan, R. S. Weston and A. Wolman has been appointed to report to the council by September 15, 1921.

"It is understood by the council that such portion of the funds to be reserved for its use as will not be actually necessary will be available for other activities authorized in the Association budget for the year 1921-1922."

Malcolm Pirnie, of Hazen, Whipple & Fuller, 30 East 42nd St., New York, will act as secretary of the council.

There are 15 committees engaged on the work of the council on standardization, considering the following subjects:

1. Standard Methods of Water Analysis.
2. Standards for Satisfactory Drinking Water.
3. Practical Ranges in Load Factors for Purification Plants.
4. Colloid Chemistry in Relation to Water Purification.
5. Watershed Protection.
6. Industrial Wastes in Relation to Water Supply.
7. Pumping Station Betterments.
8. Physical Standards for Distribution Systems.
9. Standardization of Services.
10. Sanitary Fountains.
11. Testing of Water Works Materials and Supplies.
12. Methods and Records of Water Waste Control.
13. Steps Toward Standardizing Stated Quantities for Slides in Meter Schedules.

14. Practical Standards of Rules and Regulations of Relations Between Water Works and Consumers.
15. Essential Data for Water Department Records and Reports. (A) Municipal Plants. (B) Privately Owned Plants.

These are the subjects which have held the attention of the Association in its conventions from year to year. These committees of the council are expected to co-ordinate and crystallize the more or less informal and disconnected talks previously given on the several subjects into something like a code of recommended practice. In other words, specific recommendations as to procedure are to be formulated for the guidance of the individual water works operator or engineer. That very great good will result from these labors cannot be doubted if the Association as a whole lives up to the opportunity now presented.

This year, as always, great interest was shown in selecting the next convention city. The following cities invited the Association to held its 1922 convention with them: Atlantic City, Baltimore, St. Joseph, Mo., Detroit, Philadelphia, Kansas City, New Orleans, Washington, D. C., and Dallas, Tex. The convention committee suggested that the choice be made between Baltimore, Kansas City and Philadelphia. After one ballot Kansas City withdrew in favor of Baltimore, but on the second ballot Philadelphia received a majority of all votes cast, so the 1922 convention will be held in Philadelphia.

WATER MAIN CLEANING IN KANSAS CITY, MO.

By Charles S. Foreman, First Assistant Engineer, Water Department. City Hall, Kansas City, Mo.

Water works engineers and superintendents usually know the necessity of cleaning certain water mains or feeder mains in the system which they may be operating but before they are able to obtain authorization and appropriations to cover such work, they are called upon to answer many questions which may be brought up before a board of commissioners.

The author believes that the publication of his experiences in the line of water main cleaning in Kansas City during the past three years will be of value to other water works superintendents desirous of instituting similar work in the system under their jurisdiction and that the following essential facts based upon his experiences will help to answer some of the questions which are usually asked.

Essential Facts Based on Experience

1. That the cleaning can be so arranged that a main need not be out of service longer than 12 hours for cleaning.

2. That the cleaning process is not injurious to the mains.

3. That an increase in carrying capacity of from 60 per cent to 85 per cent was obtained in large mains and that the carrying capacity of such mains was restored to that of new pipe.

4. That the saving in coal costs alone, derived from cleaning will pay the entire cost of cleaning within from 1 to 3 years.

5. That the laying of additional mains to obtain increased capacity can be postponed until the consumption demands are equal to the maximum capacity of the old main on the basis of new pipe.

6. That when taking as credits, such items as coal saving and postponement of obligatory laying of new mains, the entire cost of cleaning is saved within 6 months to 1 year.

Local Conditions Calling for Main Cleaning

In Kansas City, Missouri, for 2 or 3 years prior to the summer of 1918 there was always a lack of adequate pressure in the north and east portions of the city. This district is fed from the Turkey Creek Pumping Station through one 20 in. and one 30 in. cast iron water main. The question of laying additional feeder mains into these districts was abandoned because of the exceedingly high prices of material and the lack of funds. Therefore the proposition of increasing the carrying capacities of the old mains by the cleaning process was resorted to in the fall of 1918.

Preliminary Tests

Tests were run on the 30 in. high pressure discharge line extending from Turkey Creek Station to 17th and Baltimore, a distance of approximately 6,000 ft., for determining the interior condition and carrying capacity of this pipe, the pipe having been laid in 1886. The tests were made by making taps exactly 1,000 ft. apart upon a straight length of the main, there being no services or connections to the main between gauging points. At each of these points 1 in. corporation cocks were in-

stalled for inserting pitometers and additional corporation cocks for pressure lines . Two inch pipe was connected to each of these taps and 1,000 ft. of this pipe laid along the surface of the ground bringing the two together so that a U-tube could be connected in to measure the differential pressure between the two points. The 30 in. pipe was double traversed at each pit and the average traverse co-efficient obtained. A pitometer was then set at each pit for checking quantities flowing through the 30 in. main.

The scale on the differential U-tube was graduated in 0.01 ft. divisions and by using a liquid of specific gravity of 2 in this tube, the readings obtained were in feet loss of head per thousand feet.

The advantages inherent in this method are that it is not necessary to obtain the difference in elevation between the two points, and that it eliminates the use of spring gauges. Piezometers could not be used because of the high pressure. All of the lines being under pressure of 125 to 150 lbs. per square inch.

The pipe and connections for bringing the two pressures to the differential U-tube should be water tight for accurate results. However, we found no difficulty in making them up tight. We also found that with pipe of 1½ to 2 in. diameter a slight leak did not materially affect the results.

The test extended over a 24 hour period so that both maximum and minimum velocities in the pipe could be obtained.

The average pipe coefficient as computed by William & Hazen formula was 69.69, this being lower than that in the Williams & Hazen tables for pipe 40 years old. From these tests it was evident that the 30 in. line was far below the carrying capacity of new cast iron pipe. A contract was awarded to the Naional Water Main Cleaning Co., of New York City, for the cleaning of 6,000 feet of this 30 in. pipe.

Similar tests were run after the pipe had been cleaned. The average pipe coefficient was brought up to 116, and at low velocities as high as 120. The carrying capacity of this pipe having been restored to nearly that of new pipe.

Preliminary Work Leads to Contract for Extensive Cleaning

The cleaning of the 30 in. pipe gave such excellent results that a contract was let to the same company for the cleaning of additional feeder mains into the northeast section of the city, there being 30, 24, 20 and 16 in. pipe lines in this contract.

Similar tests were run on each of these pipe lines both before and after cleaning. In all of these cases the pipe after being cleaned was restored to carrying capacity and corresponding loss of head as indicated in Williams & Hazen tables under coefficient 120.

In making the test on the smaller lines, we were unable to place the gauging taps 1,000 ft. apart because of service connections and connections at street intersections. They were placed at 200 ft. 250 ft. and 500 ft. apart, depending upon conditions encountered.

The liquid used in the differential U-tube was a mixture of carbon tetra chloride and bromoform brought to the required specific gravity by the addition of gasoline. The specific gravity was varied in accordance with the variation in distance between taps on the line to be tested so that in each case the readings on the U-tube were directly in foot loss of head per thousand feet.

In the spring of 1919, similar tests were made on the 36 in. flow line from the low service station at Quindaro to the Kaw River Tunnel, a distance of 17,000 ft. It was found that the average pipe coefficient as computed by the Williams & Hazen formula was 71.5 and that by cleaning this line the coefficient was restored to 122.33.

The Methods Used in Cleaning

The methods used by the National Water Main Cleaning Company for cleaning large mains is a very simple one. The section of pipe to be cleaned is valved off and a cut made at each end sufficient to admit entering and removing the cleaning machine.

After cuts are made and the machine inserted the pipe is then sleeved up and the joints poured, after which the water is turned on behind the machine. After the machine once starts moving it travels very rapidly through the main (3 to 4 ft. per second), coming out at the open end of the section to be cleaned and bringing all the dirt and encrusting material out ahead of it.

The actual time any section of main is out of service depends almost entirely upon the speed which can be made in making the necessary cuts in the pipe and sleeving them up as the actual traveling of the machine from one end to the

other of a section of pipe requires but very little time. Usually the cuts on large mains can be so arranged that they can be made and repaired in approximately 12 hours so that it is only necessary to have the main out of service for that length of time.

The actual cutting and repairing of the various mains was done by department forces while all of the other work such as excavating, backfilling, placing of machine, etc., was done by the contractor.

Cost of Cleaning Mains

The contractor's price for cleaning ranged from 26 cts. per foot for 16 in. pipe to 45 cts. per foot for 36 in. pipe and the total cost, including all expenses for operating valves, cutting and repairing pipe and for all necessary sleeves and material was $22,046.09 for 43,857 lin. ft. of pipe cleaned or 50.3 cts. per lineal foot for all sizes.

The total cost of cleaning the various sizes, including pavement repairs and operation of valves, etc., was as follows:

7,202 ft. of 16 in. pipe—$2,472.52 or 34.3 cts. per lin. ft.

7,280 ft. of 20 in. pipe—$3,056.80 or 41.9 cts. per lin. ft.

3,371 ft. of 24 in. pipe—$1,813.56 or 53.5 cts. per lin. ft.

8,984 ft. of 30 in. pipe—$5,604.93 or 62.3 cts. per lin. ft.

17,000 ft. of 36 in. pipe—$9,098.28 or 53.5 cts. per lin ft.

Increase in Carrying Capacity Due to Cleaning

The average flow through the 30 in. pipe from Turkey Creek Station to 17th and Baltimore before cleaning was 11.1 million gallons per day and the friction loss was 4.23 ft. per thousand feet. After being cleaned, with the same quantity of water passing through the pipe, there was a friction loss of 1.6 per thousand feet or a net gain of 2.62 ft. per thousand feet amounting to 15.78 ft. for a total of 6,000 ft. cleaned. This was also checked approximately with pressure gauges at each end of the line and is equivalent to a saving of 1,460 million foot pounds of work per 24 hours.

Had this been a line through which we desired to deliver 11.1 million gallons of water per day at a certain head, there would have been an actual saving in coal of $6.67 per day or $2,504 per year, so that the saving in 1 year of coal alone almost equals the cost of cleaning.

However, as we carry a constant station pressure of 150 lbs., the cleaning resulted, either in increasing the pressure in the down town district 15.78 ft. with the same quantity of water passing through the line or with the same loss of head as before cleaning, the quality delivered through the line would be approximately 19½ million gallons per 24 hours, or an increase in carring capacity of 8.4 million gallons per day or nearly 80 per cent.

To obtain the same increase in capacity as the cleaning of the 30 in. pipe resulted in, would mean the laying of an additional 24-in. feeder main. The estimated cost of such a line at that time was $88,800 and the annual interest on this amount at 5 per cent is $4,440, making a total annual saving of $6,944 as against a total cost for cleaning of $3,720.50.

In the case of high pressure distributing mains the cleaning of the 26,000 ft. of various sized pipe now enables the delivery to the northeast section of town of approximately 12 million gallons per day more water than before cleaning without increased head at the pumping station. Therefore, it will be readily seen that the laying of additional feeder mains can be postponed for some time by keeping the present mains up to their maximum carrying capacity.

In the case of the 36 in. flow line, it was found on the test before cleaning that with a loss of 2.7 ft. per thousand feet the line was flowing 16 million gallons per 24 hours. This was practically the minimum amount of water that it was possible to put through this line with the limiting head of 50 ft. on the Quindaro pumps. The test after cleaning indicated that with the same loss of head, the capacity had been increased to approximately 26 million gallons or 75 per cent.

In other words, this gave the department an increase in flow line capacity of approximately 10 million gallons per day, which was greatly needed during the periods of maximum consumption in the summer of 1919. Under normal conditions of consumption, the cleaning of this flow line actually resulted in a saving of 1.7 ft. of friction loss per thousand feet.

Annual Costs and Saving Before and After Cleaning

The accompanying tabulation shows the length of time in service, the annual operating cost for coal, before and after cleaning of the various sizes cleaned. Also the investment required and the annual interest thereon to obtain the increased capacity by laying new mains

and the total annual saving all being based on 5,000 ft. of each size and on the normal flow through the pipe at time tests were made.

Inspection of the interior of the mains after cleaning discloses that the machine had no injurious effect upon the interior surface. The springs on the machine are not set stiffly enough to cut into the cast iron and in many instances, where inspection was made, it was found that the old tar coating was still in the grains of the iron. The machine in many instances was sent around sharp curves, some as much as 60 degree bends and also through open gate valves without injurious effect. It cleans the walls of the pipe very thoroughly and leaves it practically as smooth as new pipe.

TABULATION OF ANNUAL COSTS AND SAVINGS BEFORE AND AFTER CLEANING WATER MAINS AT KANSAS CITY, MO., WATER WORKS ON BASIS OF 5,000 FT. OF EACH SIZED PIPE.

Service Years	Size	M. G. D. Normal flow	Loss of Head Per 5,000 Ft. Uncleaned	Loss of Head Per 5,000 Ft. Cleaned	Annual Coal Cost To Operate Line Uncleaned	Annual Coal Cost To Operate Line Cleaned	Annual coal saving	Size req. to obtain increase in capacity if not cleaned	Estimated cost 5,000 ft.	Interest on expenditure 5%	Total annual saving	Total cost of cleaning
41	16-in.	2.4	24.00	7.50	$462.53	$144.53	$318.00	12-in.	$27,200.00	1360.00	1778.00	1715.00
42	20-in.	3.4	23.50	5.60	641.60	152.89	488.71	16-in.	33,100.00	1655.00	2143.71	2095.00
28	24-in.	5.0	12.60	5.25	505.90	210.79	296.11	16-in.	33,100.00	1655.00	1950.11	2675.00
33	30-in.	12.0	23.50	9.00	2264.46	867.24	1397.22	24-in.	70,000.00	3500.00	4897.22	3115.00
33	36-in.	16.0	15.25	6.00	3740.52	1471.68	2268.84	30-in.	73,500.00*	3675.00	9618.84	2675.00

Annual cost for fuel to pump one million gallons 1 foot high at Quindaro, $0.042.
Annual cost for fuel to pump one million gallons 1 foot high at Turkey Creek, $0.022.
*No pavement or rock.
Surface supply, Missouri River water.

Rapidity of Corrosion After Cleaning

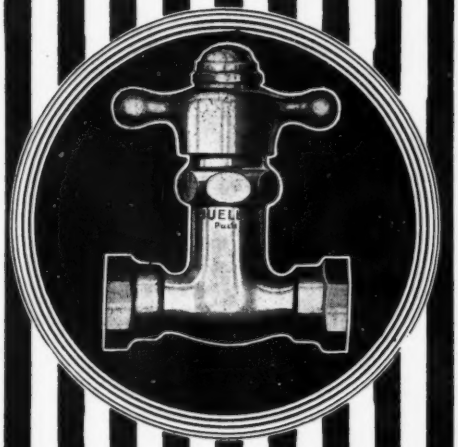
As to the question of how long the benefits derived from the cleaning of water mains may be expected to last, the author has heard it stated many times that after a pipe had once been cleaned the corrosive effect or the formation of barnacles was very much more rapid than before cleaning. In fact, the contractor stated that the carrying capacity might decrease the first year but would be less rapid thereafter. With a view to ascertaining what this effect would be on the 30 in. main, permanent pitometer pits were put in so that tests could be run from time to time after the cleaning. Accordingly pitometer and loss of head tests were run again in the fall of 1920 on this main. Two years after cleaning there was practically no change in results from the test run immediately after the pipe was cleaned. This would tend to indicate that the corrosive action is no faster after cleaning than an ordinary new pipe.

The author believes that in the designing and laying of new feeder mains, serious consideration should be given to the advisability of building permanent pits with removable sections of flanged pipe so that a main can be readily and cheaply cleaned from time to time.

It is now the common practice among engineers, when computing the size of pipe required to deliver a certain quantity of water, to use the loss of head figures as given in Williams & Hazen tables under coefficient 100, thus providing a larger size than necessary under coefficient 120.

It can be readily seen that the interest on the saving in first cost between the smaller and larger pipe will far more than pay the cost of maintaining the smaller pipe at its maximum capacity by cleaning whenever necessary.

This paper by Mr. Foreman was presented at the 1921 meeting of the American Water Works Association.



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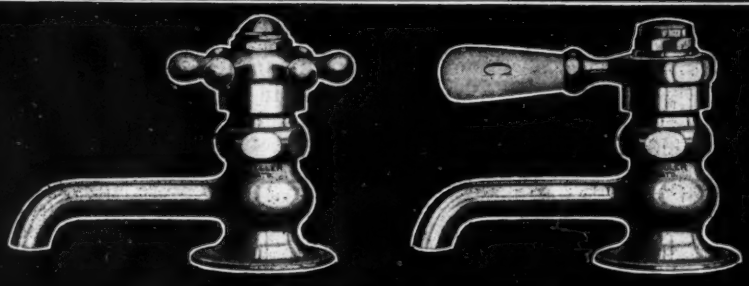


RESULTS PRODUCED BY EXPERIMENTAL BAFFLES AT MONTEBELLO FILTERS OF BALTIMORE WATER WORKS

By James W. Armstrong, Filtration Engineer, Montebello Filters, Hillen Road, Baltimore, Md.

Montebello Filters are provided with two coagulating basins that are operated in parallel, apparently under similar conditions. Float observations and surveys of the mud deposits made at various times showed different results for each basin, and revealed the fact that different parts of the basins had different subsiding values, the heavier mud deposit coinciding closely with the maximum velocity of flow. The general tendency was to deposit silt heavily against the baffle wall on the incoming side, and against the outer wall on the outgoing side, the deposits sloping to a minimum depth in The water, as would naturally be expected, followed the line of least resistance; consequently as the basins silted up and became shallower, it passed through them at a more uniform velocity.

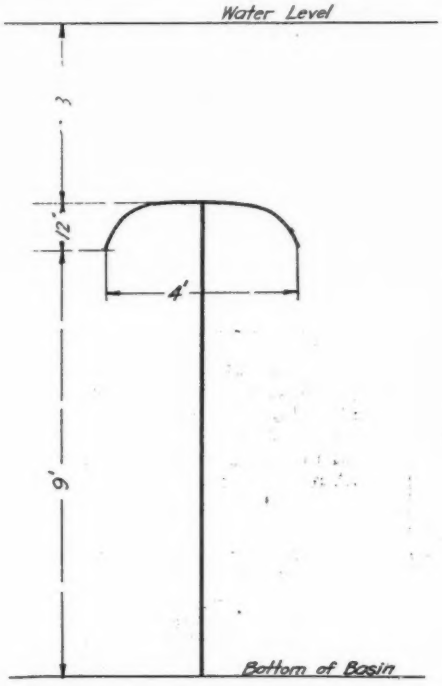
Each of the coagulating basins is 317 ft. long, 232 ft. wide, and has an average depth of about 15 ft.

A central baffle wall extends about three-quarters of the length of each basin. Water is admitted through five sluice gates, spaced at equal intervals, and after passing around the baffle, is withdrawn through a similar number of gates. The water passes over a baffle at the entrance and over a skimming wier at the exit.

In addition to the variations in velocity and the lack of uniformity in mud deposits, other irregularities were noticed in the functioning of the basins. As an illustration, it was noted on one occasion that Basin No. 1 gave decidedly better results than Basin No. 2, but upon making a slight change in the opening of one of the inlet gates, the condition was shortly reversed and Basin No. 2 gave markedly better results than Basin No. 1.

This phenomenon raised the question as to the possible effect of undercurrents upon the subsiding value of the basins. It was argued that if the elements of the water in moving through the basin could be kept in nearly parallel lines and if the movement could be confined to the surface of the water, leaving the lower stratum undisturbed, much greater subsiding value could be obtained.

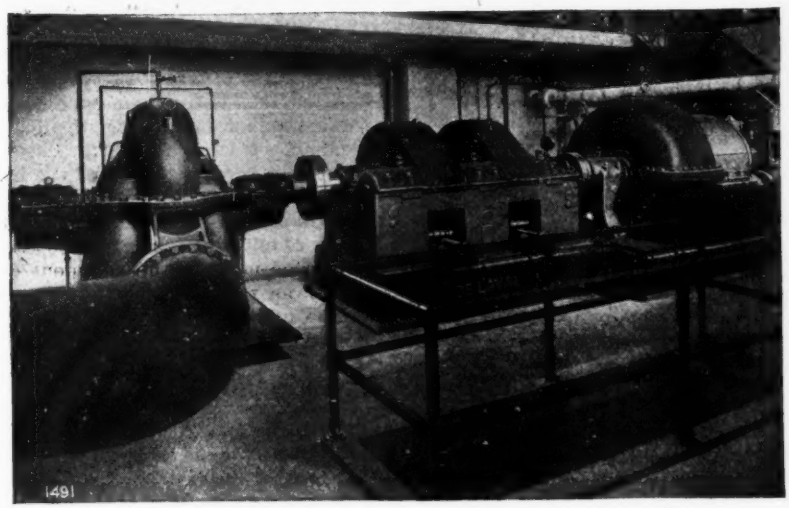
With the purpose of testing out this theory, some modifications were made in the existing entrance baffle, and an additional cross baffle was built in Basin No. 1. Basin No. 2 was not touched. In order to give a positive outward sweep to the water entering the basin, increase the surface velocity, and prevent returning undercurrents, a wooden apron about 2 ft. wide and sloping in an upward direction was attached to the top of the existing entrance baffle. No changes



SKETCH SHOWING OUTLINE OF WOODEN BAFFLE ACROSS COAGULATING BASIN NO. 1, MARCH 20, 1919.

were made at the outlet skimming wier. At the end of the existing concrete baffle, about 240 ft. from the entrance, an additional wooden baffle was built entirely across the basin. This baffle was made of ⅞ in. flooring, and was thoroughly anchored to the concrete floor of the basin. As it was not designed to carry hydrostatic pressure, a number of swinging doors hinged at the top were provided to relieve the pressure at times of filling and cleaning. The new baffle was 10 ft. high and was capped with a top 4 ft. wide, which projected 2 ft. on each side. The top was curved downward at the ends in the form of a parabola. Water usually flowed about 3 ft. deep over the top of the baffle.

The following reasoning was respon-



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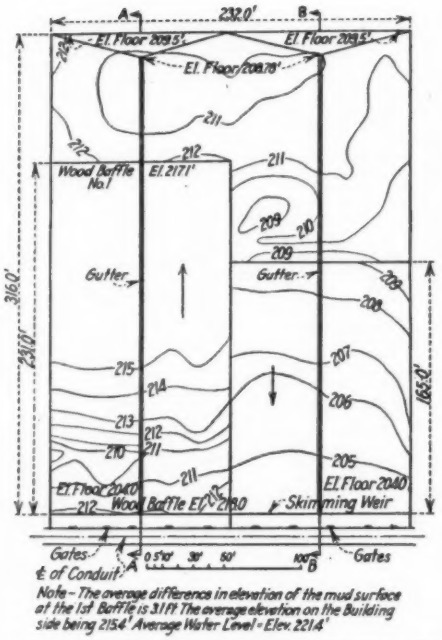


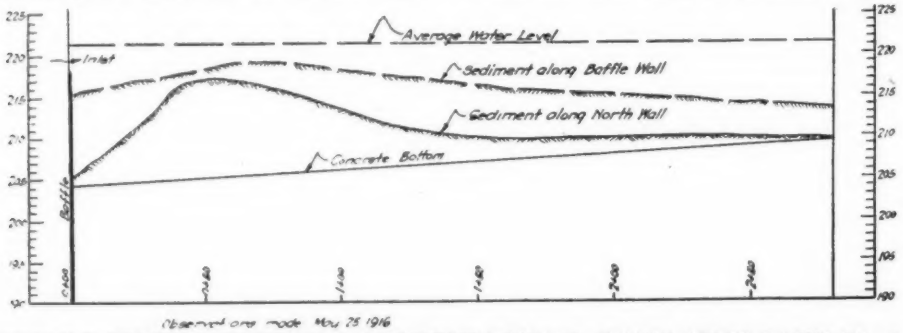
PLAN SHOWING SILT DEPOSIT IN COAGULATING BASIN NO. 1, ON DEC. 31, 1919.

sible for the building of the unusual type of cross baffle:

The reduction of the cross sectional area would tend to establish a more uniform flow across the top of the basin at the baffles, and would create a quiet zone near the bottom that would permit better sedimentation. It is well known that when flowing water meets an obstruction such as a baffle, there is a decided tendency to pick up sediment and carry it over the top, and it was reasoned from the known characteristics of a parabola to reflect rays of light in parallel lines, that the sediment in the rising currents of water, would, upon striking the parabola, be thrown downward and deposited, instead of being carried over into the next compartment. The curved top over the rear of the baffle is only useful in gradually reducing the velocity of water flowing over it.

After this baffle had been in service for a number of months, the basin was cleaned. It was found that the apron extending across the top of the baffle at the entrance of the basin had been built a little too near the surface, and the velocity of entering water was so great that it carried most of the sediment outward as far as the cross baffle. The results at the cross baffle, however, were most gratifying. The parabolic top had evidently acted exactly as had been anticipated, for the mud was deposited adjacent to the baffle, almost to its full height, and sloped gradually backward to the entrance of the basin. The baffle on the return side had not performed so well, probably owing to the fact that the water in passing over it was not flowing in a direction normal to its face.

The swinging gates placed in the wooden baffles for relieving them of hydrostatic pressure operated successfully when the basin was being filled, but when the time came for removing the mud it had become so firmly compacted against the baffles that the swinging gates could not operate and the baffles collapsed. As the accident happened in cold weather, no attept was made to repair the baffles until June, 1919, when No. 1 across the north half of the inlet side of the basin was rebuilt in its original position and the one in the south half was moved forward about 50 ft. In moving it forward, the sloping bottom of the floor had the effect of lowering the elevation of its top 1.2 ft. The position of the hinges on the swinging gates was changed from the top to the bottom and heavy wooden strips were secured to the top. The bouyancy of the wood shut the gates and held them in position as long



PROFILE SHOWING EXTENT OF SEDIMENTATION IN COAGULATING BASIN NO. 1, MARCH 18, 1919.

It *Pays* to Clean Water Mains

Writing in *Municipal and County Engineering* for June, 1920, the Water Commissioner of St. Louis, Mo., said:

> "The best evidence of the beneficial effects of water main cleaning in St. Louis lies in the fact that this work is being continued from year to year."

The same opinion is held by practical water works men in many other American cities. Some cities have entered into as many as ten separate water main cleaning contracts from time to time, and the list of cities that have made three or more such contracts is long and impressive. Over 25 cities have entered into second contracts, and well over 100 cities have entered into at least one contract for the mechanical cleaning of water mains.

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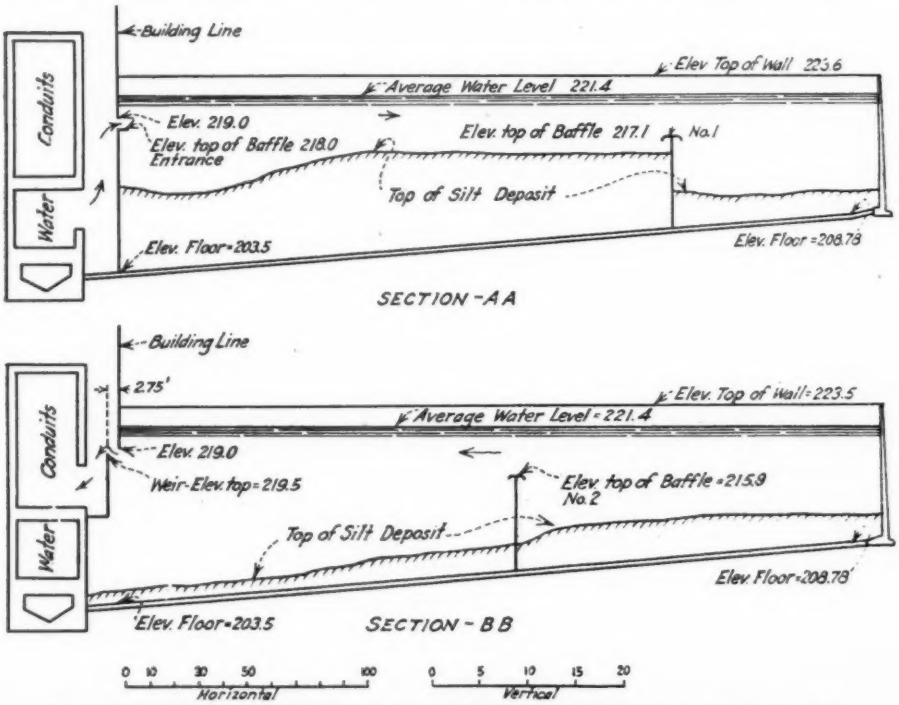
as water was in the basin, but as soon as the water was withdrawn below the top of the gates, the weight of wood on top and the pressure of water behind opened the gates. No further trouble was experienced when the basins were cleaned, although mud was packed solidly against the baffle No. 1 from top to bottom.

The plan and profile of the basin show the surface of the mud, and the location and elevation of the baffles on Dec. 31, 1919, when a careful survey of the mud surface was made. An inspection of these diagrams indicated that the sediment was carried forward for a distance of about 100 ft., and from that point to baffle No. 1 it was deposited very evenly. At the baffle there was an abrupt drop in the mud surface of about 3 ft., and from there on to baffle No. 2 there was some irregularity of deposit, as might be expected, due to the change in direction of the flow. From baffle No. 2 to the skimming weir the deposit was also fairly uniform.

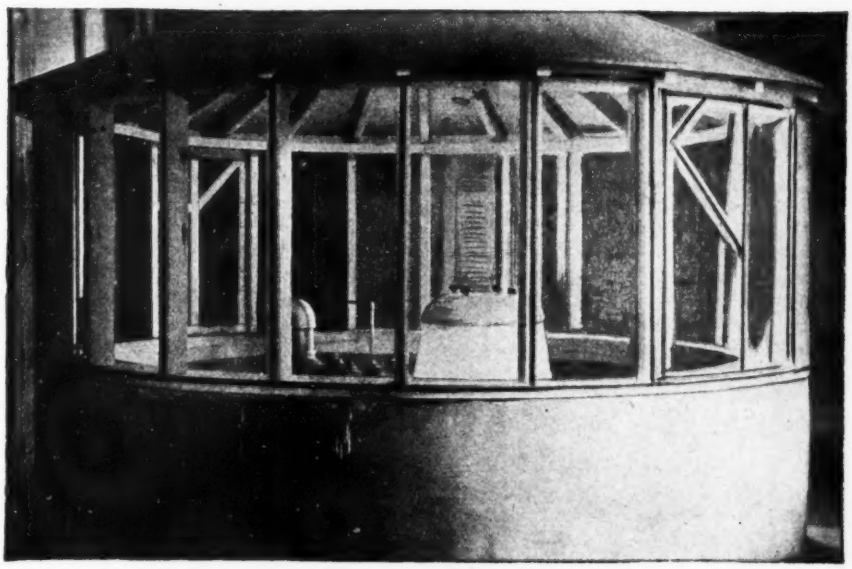
During this period of service the rate of flow ranged from 80,000,000 to 154,000,000 gals. per day and averaged 114,000,000 gals. In the accompanying table the depth of water over the baffle and the velocities at various rates are given.

The velocity at the entrance baffle is too high to secure satisfactory subsidence as is evidenced by the fact that only the heavier particles of suspended matter settled out before the water had traveled nearly 100 ft. At baffle No. 1 the velocity ranged between 0.25 and 0.48 ft. per second with an average of 0.35 ft. The result is apparently quite satisfactory at this baffle, and the velocity must have been nearly equal across the entire basin, as the mud deposits were nearly level, in marked contrast to the sloping surface of the mud as shown when the reservoir was cleaned on various occasions prior to the placing of this baffle.

At baffle No. 2 the velocity is somewhat lower than at baffle No. 1 on account of its top being a greater depth below the water surface. The distribution of sediment at this baffle is not nearly so good as it is at baffle No. 1. The contour map shows the greater deposit on the south side of the basin. The indications are that the velocity over this baffle is a little too slow, and if its top had been raised from 1 ft. to 1½ ft. higher, the probability is that a more uniform deposit of sediment would have been secured. The velocity of the water in passing over the skimming weir va-



PROFILE OF SILT DEPOSIT IN COAGULATING BASIN NO. 1, DEC. 31, 1919.



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80,000,000	1 ft.	1.15	4.3 ft.	0.25	5.5 ft.	0.19	1.9 ft.	0.60
100,000,000	1 ft.	1.46	4.3 ft.	0.31	5.5 ft.	0.24	1.9 ft.	0.75
114,000,000	1 ft.	1.65	4.3 ft.	0.35	5.5 ft.	0.27	1.9 ft.	0.86
128,000,000	1 ft.	1.84	4.3 ft.	0.39	5.5 ft.	0.31	1.9 ft.	0.97
140,000,000	1 ft.	2.01	4.3 ft.	0.44	5.5 ft.	0.34	1.9 ft.	1.06
154,000,000	1 ft.	2.20	4.3 ft.	0.48	5.5 ft.	0.37	1.5 ft.	1.16

SUSPENDED MATTER.
In Parts Per Million.

Month	1919. Coagulating Basin No. 1	Coagulating Basin No. 2	Month	1920. Coagulating Basin No. 1	Coagulating Basin No. 2	Month	1921. Coagulating Basin No. 1	Coagulating Basin No. 2
January	5.7	5.5	January	7.5	9.4	January	3.6	3.8
	(Partially cleaned Feb. 9)			(Partially cleaned Jan. 24)		February	4.1	4.4
February	8.0	8.2	February	12.0	9.9	March	3.5	3.7
March	7.6	7.9		(Partially cleaned Feb. 15)				
April	6.7	6.9	March	7.0	12.2			
May	5.7	3.8	April	5.2	6.5			
	(Partially cleaned May 8)		May	3.5	3.8			
June	4.6	6.7	June	3.7	5.6			
	(Cleaned June 11, Baffle reconstructed)		July	9.0	11.0			
			August	11.1	7.5			
July	3.0	3.9			Partially cleaned Aug. 17)			
August	3.9	6.1						
September	4.2	5.0	September	5.1	6.4			
October	4.7	4.4		(Cleaned Sept. 11)				
November	4.8	5.9	October	4.7	5.7			
December	4.5	6.9	November	4.2	8.0			
					(Cleaned Nov. 30)			
Baffles rebuilt June, 1919.			December	4.7	4.7			

ries from 0.6 to 1.16 ft. per second, and is undoubtedly too high for satisfactory results, as it was noticed on many occasions that sediment was picked up and carried over the weir. At times, when stop planks were removed from the baffles, a lighter and more uniform floc was noticed in the water as it passed through the gates to the filters.

In order to compare the subsiding values of Basins No. 1 and No. 2 which are practically identical with the exception of the new wooden baffles built in Basin No. 1, daily reports of suspended matter and turbidities have been kept, and a table has been prepared showing the suspended matter in the basins by monthly averages from January, 1919, to March, 1921. The water entering the two

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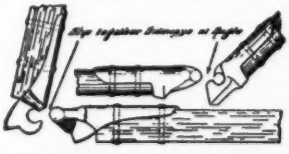

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basins is practically identical, the chemicals having been incorporated in a common mixing chamber before passing to the coagulating basins. The times of cleaning or partial cleaning the different basins is indicated. The word "cleaning" indicates that the sediment was entirely removed from the basin and it was thoroughly cleansed by hosing out with water under high pressure. "Partial cleaning" is accomplished by allowing the sediment to flow out through the drains without hosing. In this way approximately four-fifths of the sediment can be disposed of.

For the first five months in 1919, during which the wooden baffles in Basin No. 1 were in a partially collapsed condition, the two basins did almost the same amount of work, Basin No. 2 giving slightly better results. In June Basin No. 1 was thoroughly cleaned and the baffles rebuilt. From that date until December, 1919, when the survey was made, Basin No. 1 showed an average of 4.2 and Basin No. 2 an average of 5.4 parts per million of suspended matter going onto the filters. Beginning with 1920, due to cold weather and bad water, it was impractical to clean Basin No. 1. As a number of storms occurred, bringing very heavy sediment to the plant, Basin No. 1 was filled with mud to a height about the top of No. 1 baffle by the time it was cleaned on the 15th day of February. For a month and a half during this period of high turbidities Basin No. 1 did very much poorer work than No. 2, owing to the fact that it was nearly full of mud, but immediately after cleaning, it did very much better work than No. 2, as is shown by the results in the table.

The observations seem to indicate that a velocity from 0.35 to 0.4 of a ft. per second over the top of the baffle will give a fairly uniform flow, which will secure nearly equal subsiding values in all parts of the basin; that the velocity over the entrance baffle and skimming weir is too great ,and that better results would probably be secured if it were reduced; that the efficiency of Basin No. 1, even with the improper velocity at all the baffles except No. 1, is markedly better than No. 2, so much so, that at times of high turbidity the difference of effluent from the two basins is so great that it often presents a marked contrast to the eye.

Records made subsequent to Feb. 15, 1920, indicate that Basin No. 1 showed better results than No. 2, except at times when Basin No. 1 was very dirty and No. 2 fairly clean. This will become more apparent in studying the table showing the suspended residue in the effluent from each of the basins. The greater the turbidity of water entering a plant, the more important an efficient coagulating basin becomes, and it is at times of extremely bad water that they become indispensable, and their proper functioning is of the greatest importance. The monthly averages as shown, therefore, do not indicate the real value of the work done by the coagulating basins. For instance, in the early part of 1920, water came to the plant with a turbidity as low as 6. Under such conditions the coagulating basins could not remove any of the suspended matter and in most cases owing to the fact that they were not entirely clean, the suspended matter was actually increased in passing through the basins. In expressing the work of the basins in percentage, an increase would be shown, but at such times the coagulating basins are of no practical value. As an illustration of the work that can be done by coagulating basins: In March, 1920, for a period of nearly two weeks the river water ranged in turbidity from 200 to over 1,000, and during that period of time, the percentage of suspended matter removed by the basins was from 89 to 99 per cent. During the interval mentioned above, Basin No. 1 showed a removal of turbidity greater than Basin No. 2, although both were cleaned within a space of 21 days of one another.

COUNTY ESTABLISHES OWN STORAGE PLANT

Bergen County, New Jersey, has prepared plans for a complete storage plant for bituminous road materials used in road construction and surface treating, to be located at Hackensack, the county seat, and having a capacity of 1,500,000 gals. The plant will consist of four 50,000 gal. storage tanks, two 4,000 gal. heating tanks and a hollow tile storage warehouse 25 ft. by 40 ft. in size. The county officials expect to save large sums of money in storage costs through the erection of the new plant.

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OWNERSHIP AND OPERATION OF TRENCH EXCAVATORS AND OTHER MECHANICAL EQUIPMENT BY THE WATER DEPARTMENT OF BALTIMORE

By V. Bernard Siems, Associate Civil Engineer Water Department, Oliver and Wolfe Sts., Baltimore, Md.

(Editor's Note: The following matter is the major portion of a paper presented by Mr. Siems at the 1921 annual convention of the American Water Works Association. The original paper was accompanied by numerous tables and diagrams which are too extensive for reproduction here, except in substance, but which, presumably, will be reproduced in full in the Journal of the Association at an early date.)

Machinery for excavating earth and other material has been recognized for years as more economical and efficient than manual methods where conditions will permit the use of such mechanical equipment.

In order to complete the construction of water supply and sewerage systems in the cantonments during the world war as quickly as possible, the United States Army used machinery entirely, and the results obtained have, no doubt, had a great effect on the increased use of trench excavators, cranes and backfillers by contractors and municipalities. The writer used trenching machines, cranes and backfillers entirely for the construction of the water distribution system for Camp Meade and Camp Franklin in 1918. The distribution system of Camp Franklin and the enlargement of the Camp Meade system were completed in 2½ months. Machinery of all characters was used to construct the intake and pumping stations and enlarge the filtration plant and balancing reservoirs at Camp Meade.

In 1913 the engineers of the Baltimore City Water Department saw the necessity for obtaining a trenching machine, air compressor and pneumatic hammer to execute more expeditiously the work in connection with the installation of water mains. The Highway Department in 1913 graded 33rd Street from Greenmount Avenue to Hillen Road, an approximate distance of 1.1 miles, preparatory to constructing a boulevard. The Water Department started the work of installing a 16-inch Middle Service water main by hand labor, and as the cost of doing the work was exceeding the estimated amount appropriated, the Department engineers rented a trenching machine from the Consolidated Gas Company; with the use of this machine the work was rapidly pushed to completion and the cost was less than the amount actually appropriated. This rented machine excavated 2,000 linear feet of trench, and the final cost showed that the excavating had been done at 16 cts. a cubic yard. Based on this excellent showing, the Water Department was permitted to purchase a "Parson's" trench excavator, Model "K." Another important reason for permitting the purchase of a trenching machine was that the greater part of future water mains installations would be in the northeastern and northwestern sections of the city where few, if any, subsurface structures would be encountered, and conditions would be ideal for operating trenching machines. The normal corps of 15 laborers was too small to permit constant operation of the trenching machine in the work of laying water mains and backfilling, and it was necessary to increase the number of men. In order to still increase the amount of work and bring the water mains construction corps to the normal size of 15 laborers air compressors and pneumatic hammers were procured. This latter equipment was also necessary to secure uniform caulking of all pipe joints and, thereby, decrease the possibility of leaks occurring after the laying of improved paving; it also reduced the time, and consequently the cost of labor, in caulking.

The first air compressor purchased was of "Foster & Hosler" make and had a capacity of approximately 80 cu. ft. Considerable difficulty was experienced in training the caulkers to use the pneumatic hammers intelligently in order to prevent breaking the bells of cast iron pipe. Tests conducted over a long period showed that pneumatic hammers should

operate under a long stroke and at a moderate working pressure of 40 lbs. per sq. in. The Engineering and Construction Division of the Water Department now has the following equipment:

Equipment	*Original Cost*
4 Air Compressors (ranging from 80 to 210 cu. ft. capac.)	$ 8,189.00
2 Backfillers	3,488.00
1 Austin 5-ton Crane	8,095.00
1 Ransom Concrete Mixer	802.00
1 Air Piling Hammer	275.00
10 Ditch Pumps	3,447.00
3 Trenching Machines	23,794.00
Total	$48,090.00

Most of the machinery was purchased by the Water Department between the years 1918 and 1920. Since the year 1914 the Water Department has used trenching machines under almost all conditions in the installation of water mains in public highways.

The "Parson's" Model "K" trenching machine was put to a severe test at one time in excavating for the installation of a 4-inch water main in a private alley between 10 and 12 ft. in width. Difficulty was experienced in getting a trenching machine of this size in the alley, and damage was done to the wooden fences on each side of the alley. Even considering the difficulties and the expense entailed because of the damage done, the cost of installing the 4-in. main was much less than it would have been if done by manual labor. It may be interesting to note that a comparison of the cost of doing work in private alleys of various widths and public highways, whether done by manual labor or by trenching machine aided by hand labor, shows that the cost of the installation in private alleys is twice that of the cost in public highways. The Water Department, therefore, does not even consider the installation of water mains in private alleys. Judging from our records of cost, such installations should be discouraged by all municipalities.

Trenching machines have also been used to remove the cover of all sized water mains where it has been found necessary to enlarge or replace them by other mains, particularly so in cases where it is necessary to lower the water mains because of a change in the grade of the public highway. In the residential and business districts where it would be economical to excavate trenches with trenching machine for installation of water mains, accurate locations were obtained of water supply, gas supply and other services in advance of the work. The locations of these services were marked on the curb line, and the trenching machine operator very seldom disturbed any of them, as he raised the boom of the machine as it approached these marks. It was, of course, necessary to do the extra excavating around the service pipes by hand labor. In other instances the Department has found it economical to disconnect these services temporarily, in order to provide clearance for the operation of the trenching machine. Even with these additional costs there was considerable economy in the use of the trenching machine, especially on the installation of large water mains. From our cost data records, it is estimated that damages to subsurface structures by the use of trenching machines approximate 1% of the total cost of the installation of the water mains.

In 1918, due to the increasing number of extensions of water mains, the scarcity of labor and the high rate of pay necessary because of the salaries paid labor by industrial plants in and around Baltimore, it was decided to purchase additional trenching machines, a 5-ton "Austin" crane and backfillers. The cost of installing water mains was materially lessened by the use of this machinery in years 1919 and 1920. The 5-ton crane saved us considerable money, as we handled practically all cast iron water pipe and fittings of 20 in. and over with it.

Two types of backfillers are used—one the boom drag and the other the scraper drag. The boom drag is used on the backfilling of trenches for large mains and the scraper drag on smaller mains in territories where the Highways Department will permit backfilling of ditches by puddling the material. We have, however, also used it in public highways where ramming was necessary. Tests made with mechanical tampers have not shown satisfactory results thus far. It is hoped that they will be developed to the extent of the other machinery now used by the Water Department. We have a much larger equipment of machinery than that enumerated in machines of a smaller character which we purchased from time to time and which are not enumerated here. I believe that the Water Department of the City of Baltimore ranks first among the American municipalities in the use of machinery for doing the work in connection with the in-

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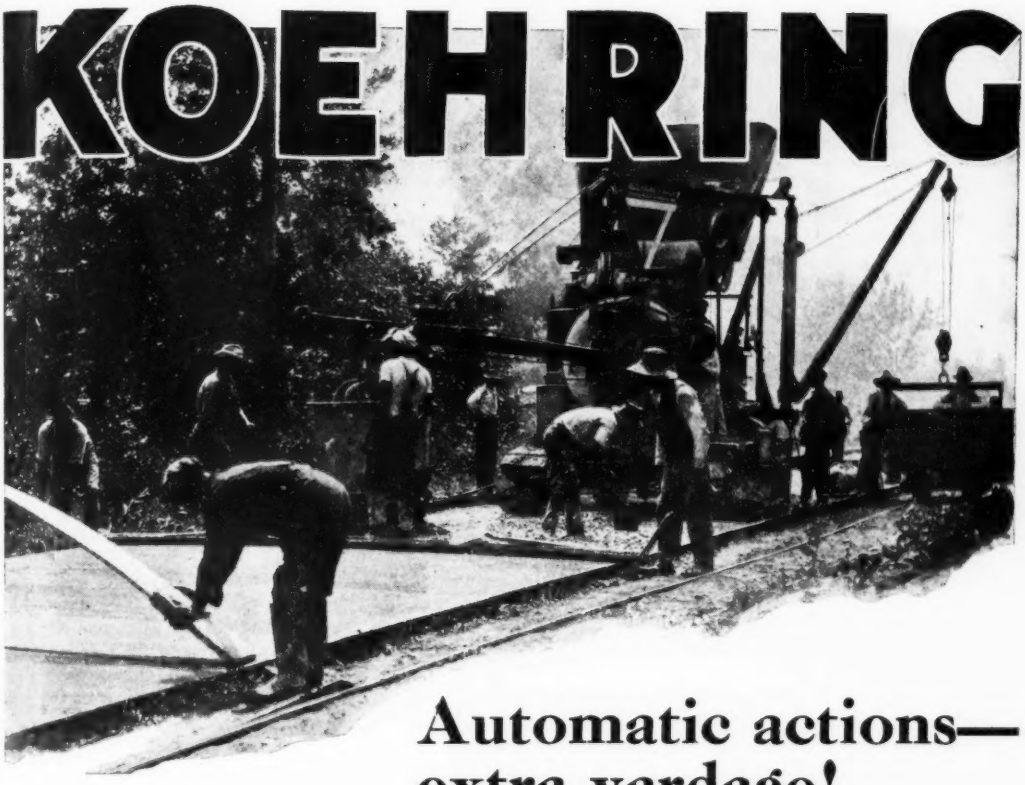

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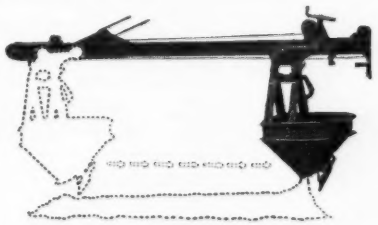

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The City Service Commission of Baltimore requires that an automobile repairman must have an elementary education, several years' experience in assembling or repairing and operating gas engines and other mechanical equipment; for handymen it requires an elementary education, one year's experience as general handyman in a machine shop and ability to follow instructions from an automobile repairman. The handymen are also used for burning out lead in cast iron pipe bells on mains of the larger size. From experience it has been found that the best men available for positions of automobile repairmen are those advanced from the position of handyman.

Experience in the use of mechanical equipment has proved to us that it is more economical and efficient to have a storage of duplicate mechanical parts available for any emergency than to order the repair parts when needed. The automobile repairmen, grade No. 1, in charge of mechanical equipment is held responsible for stock parts of mechanical equipment, and also for repairs to machinery. After the completion of the work the machinery is inspected thoroughly before being transported to another location, and, therefore, it is always in good working condition to commence the next work.

During winter months trenching machines, cranes, backfillers, air compressors, etc., are removed to the storage yards and completely overhauled. This is done only when there is no work on which this machinery can be used. The smaller gasoline pumps, melting furnaces, ground thawers, etc., are usually overhauled in the field.

Comparison of Costs—Hand Labor Vs. Hand Labor Aided by Machinery

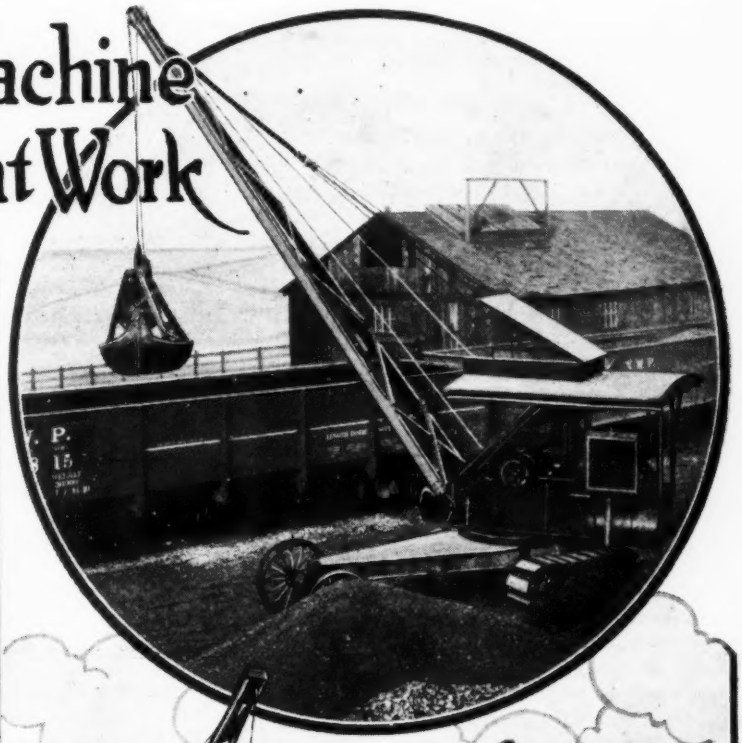
A comparison was made of labor cost per foot of installation of water mains by manual labor and manual labor aided by trenching machine. It was observed that the percentage of economy obtained using a trenching machine with hand labor varies from 22.2 to 57.5 per centum. This percentage of saving is largely due to the intelligent placing of the laborers, as for example:—with an average corps of 14 men working with a trenching machine in the installation of a 6-in. water main two laborers work on the surface to remove the material falling from the traveling buckets, three laborers are used to prepare the trench for pipe laying, two caulkers and two laborers pour the lead and caulk the joints, four laborers backfill the trench and ram the material, and one laborer attends to the lead melting furnace and keeps the water main installation corps supplied with tools. Such an organization will permit constant operation of a trenching machine throughout the working day.

A comparison was made of excavation cost per foot of installation of water main by manual labor and trenching machine aided by manual labor. The percentage of saving with the use of the trenching machine varies from 50 to 56.8 per centum. A trenching machine will excavate from 15 cu. yds. an hour in 50% rock and sandstone to 25 cu. yds. an hour in loam, gravel and disintegrated rock.

A comparison was made of average number of feet of water main installed by a man a day by hand labor and by hand labor aided by trenching machine. The term "installed" includes the excavation for installation and backfill of the water main. The saving of time in the installation of water mains by the use of the trenching machine varies from 33.3 to 80 per centum. For example, it will take a water pipe corps of 15 men installing water mains without the use of a trenching machine 10 days to excavate for, lay and backfill 300 ft. of 20-in. main. Whereas a pipe laying corps using a trenching machine to excavate the trench will complete the excavating, laying and backfilling of the 20-in. main in four days and two hours.

A study was made of the average number of men the trenching machine replaces, of the trenching machine as a labor saving device. It was found that the number of men replaced by the use of the trenching machine varies from 20 to 70 men. For an example, take a 6-in. main: The number of linear feet of trench excavated in one hour by the trenching machine is 60, but it would require 20 men to excavate the 60 ft. of trench in one hour. The same principle

Same Machine Different Work



A highway engineer or contractor uses P & H Excavator-Cranes mostly for making cuts, grading, filling-in, shouldering-up, and handling materials as sand, gravel, structural pieces; general contractors do some pile-driving in addition; industrial plants handle coal, ashes, and raw materials used in manufacture; drainage and reclamation engineers add a few uses of their own; and so it goes.

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applies to the other size mains. Thus the number of men replaced by the machine on different sizes of pipe are as follows: for 6 in., 20 men; for 10 in., 20 men; for 12 in., 21 men; for 16 in., 25 men; for 20 in., 35 men; for 30 in., 60 men; and for 36 in., 70 men.

A comparison was made of labor costs per foot of water mains between joints caulked by hand and those caulked with the use of pneumatic tools. The term "laying" refers only to the placing of the pipe in the trench and to the caulking of the joints. In comparing the cost of caulking by hand and caulking with air hammers, it was noticed that there was a loss varying from 38 to 53 per cent. in favor of hand caulking, but this loss is overcome by the saving in time, varying from 41.7 to 65.7 per cent. by caulking with air hammers, thus resulting in a saving of 36.4 to 46.7 per cent. on the completed work.

A comparison was made of backfill costs per foot of installation of water mains by hand labor and by backfiller. It was found that the percentage of saving varies from 33.2 to 52.5 per cent.

In order to determine the effective depth to which lead could be compressed in the caulking of cast iron water pipe joints, research work was initiated at the Municipal Laboratory in 1914. The results of these tests showed that lead, like other engineering materials, has a distinct characteristic curve. From this curve can be found the greatest possible compression, which never exceeds 2½ ins. from the face of the bell, before the compressive molecular resistance of the lead itself equals or is greater than the tensile strength of the cast iron in the sides of the pipe bells. When such latter is the case, there immediately follows a bursting of the pipe bell; therefore, it was recommended that air compressors and pneumatic hammers operating under a long stroke and a moderate working pressure of 40 lbs. per sq. in. be used on all the Department's caulking work.

A comparison of cost of the laying of water mains by hand labor and hand labor aided by crane on pipe 30 ins. and larger shows that it cost $0.54 a foot to lay 30-in. pipe with hand labor aided by crane, and $0.95 a foot to lay by hand labor alone, or a saving of 47.4% by using the crane. On 36-in. pipe it cost $0.70 a foot to lay with hand labor aided by crane, and $1.42 to lay with hand labor alone, or a saving of 50.7%.

The large amount of work completed by the Water Department has been due to the fact that Mr. Wm. A. Megraw, Water Engineer, has encouraged the purchase of machinery for use in the construction of water mains, which procedure was inaugurated by Mr. Walter E. Lee, former incumbent.

Due acknowledgment is given herewith to the work of Mr. G. A. Warren, Assistant Civil Engineer in charge of the construction subdivision of the Engineering and Construction Division, and to his assistant, Mr. Maurice Goldstein, Junior Civil Engineer, for the cost data furnished.

Cutting 60-in. Cast Iron Main with Oxy-Acetylene Torch

The proposed changes in the distribution system at North Avenue and Oak Street required the removal of a 60"x30" three-way and inserting of a 60"x48" three-way and connections. As the operations of the Water Department were retarding the paving of the street, a method quicker than cutting the 60-in. cast iron pipe by hand labor was desired. An oxy-acetylene torch and operator were obtained through the local sales engineer of the Davis-Bournonville Company, and the cutting of the cast iron pipe was started immediately. The progress of the cut varied from 0.63 ins. a minute to 1.3 ins. a minute, the average being 0.7 ins. a minute; the thickness of the cast iron pipe was 1.7 ins. Upon investigating the cut edges, small cracks were discovered around the entire circumference at intervals of 1.5 ft. extending from ½-in. to 1½-ins. from the face of the cut. This necessitated the removal of the pipe and the insertion of a new piece of 60-in. main. The new main was cut on the surface by hand labor, thus affording a direct comparison of the cutting of cast iron pipe by hand labor and with the oxy-acetylene torch. The following results were obtained: The cost of cutting the 60-in. pipe (2 cuts) by hand labor was $232.52, including labor, overhead, depreciation and the cost of sharpening the tools; whereas the cost of cutting the cast iron pipe (2 cuts) with the oxy-acetylene torch was $104.23, including labor, fuel consumed, depreciation and overhead.

As the result of research work now being conducted by the engineers of the Davis-Bournonville Company, I am convinced that a practical way will be found for cutting cast iron pipe economically and quickly with the oxy-acetylene torch.

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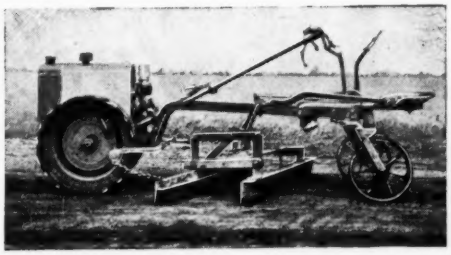

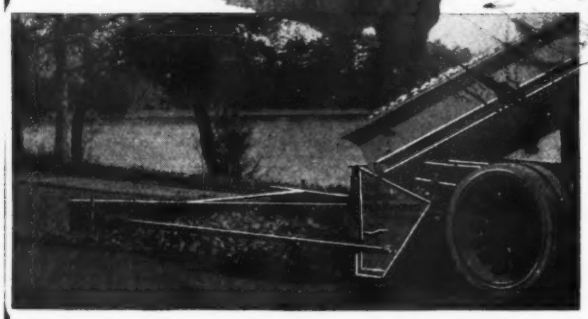

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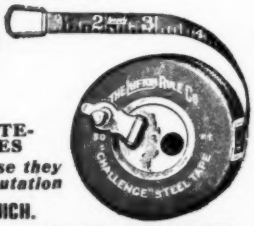

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Contracts Awarded

ROADS AND STREETS.

Ala., Selma—Ralph Lacey, City, awarded contract for paving Demopolis, Ala., amounting to $100,000. Contr. will involve 12 blks. paving on 6-in. conc.

Ark., Little Rock—Oliver Constr. Co., Little Rock, awarded contr. for constr. of road in road dist. No. 9, Crittenden Co., at approx. $40,000 per mile, or $340,000.

Cal., Sacramento—Healy-Tibbitts Constr. Co., San Francisco, awarded contract for paving with bitum. macadam 14.8 miles state highway in Nevada Co. at $217,834.

Cal., Sacramento—Contracts for state highway work awarded as follows: W. M. Ledbetter, Pacific Elec. Bldg., Los Angeles, grading 11.2 mi., San Luis Obispo Co., at $165,259; Pacific States Constr. Co., San Francisco, surfacing with Topeka 4.2 mi., San Mateo Co., at $59,500; F. C. McIntyre, Stockton, paving with conc., 11.9 miles in Solano Co., at $156,002; J. S. Caldwell, Visalia, surfacing with asph. 3.2 miles Tulare County betw. Visalia and Oak Grove Sch., at $26,837; Blumenkranz & Vernon, Stockton, bit. macadam paving on 6.6 miles in Placer County, at $155,$53; W. J. Schmidt, Berkeley, grading 5.9 mi. Amador Co., at $31,970, also contr., to Blumenkranz & Vernon, for grading 8.1 mi. Sacramento Co., at $66,852; E. Zimmerli, Palo Alto, grading 13.1 mi., Mendocino Co., at $137,735; Southwest Paving Co., 415 Washington Bldg., Los Angeles, paving with conc. 8.1 miles Los Angeles Co., bet. Lancaster and no boundary.

Cal., Sacramento—W. J. Schmidt, Berkeley, awarded contr. for grading 10.7 miles in Amador Co., bet. Ione and Jackson, at $85,499; Nevada Contr. Co., Fallon, Nev., awarded contr. for grading 13.4 miles in Mono Co., bet. Tioga Pass Rd. and Va. Crek., at $121,544.

Fla., So. Jacksonville—Jas. Y. Wilson, Jacksonville, awarded contr. for 35,00 sq. yds. paving vitr. brk. and bitulithic, at $190,000.

Ill., Chicago—State Impvt. Co., Chicago, Ill., awarded contr. for constr. of new road of 3.1 miles on 119th St., at $129,478.

Ind., Indianapolis—Fred Cunningham, awarded contr. for constr. of Rockville Rd. Wayne Twp., at $235,571; J. W. & W. C. Martin, awarded contract for bldg. 2 structs. on Arlington Ave. Rd. Warren Twp. at $97,200; Timberlake Constr. Co., awarded contr. for constr. of stretch of Allisoncille Rd., at $111,857; L. P. Beard Constr. Co., Indianapolis, awrded contr. for paving Benj. Foreman Rd. extending from S. Fifth St. to Henry Rd. east of Richmond, at $69,386.

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Ind., Lafayette—Premier Constr. Co., Indianapolis, awarded contr. for constr. of the W. C. Brown gravel rd. Tippecanoe Co., at $309,000.

Kans., Ottawa—Cook & Stucker, awarded contracts for paving and resurfacing at about $110,000. There are 37,000 yds. asph. conc. to be laid as resurfacing and 11,000 yds. brick as new pavement; old pavement to be resurfaced (36 blocks), new work (13 blocks).

Kans., Topeka—City Commrs. let contracts for paving various streets and alleys to Ritchie & Ramsey, Wichita; asph. conc. at $188,485; conc., $66,690; Kaw Valley Paving Co., 609 N. E. Bldg., brk., at $16,968; Davidson Constr. Co., Kans. City, Mo., awarded contr. for grading Central Ave. and constructing culvts. on road, at $119,832.

Kans., Troy—P. P. Young, R. F. D. 6, St. Joseph, Mo., awarded contr. for constructing 6.3 miles Pikes Peak Hwy., including conc. slab on prepared sub-grade, F. A. P. 53, A-B-C, at $201,649.

Me., Skowhegan—Ford & Smiley, Skowhegan, awarded contr. for 6.44 miles bitum. macadam surfacing here at $211,145; Jos. McCormick, 319 Taunton Ave. E. Providence, R. I., for 6 miles in Calais, at $185,604; Bruno & Petitti, 18 Tremont St., Boston, Mass. for 7.08 mi. in Gray, at $291,348.

Mich., Lansing—Contracts for constr. of roads awarded as follows: Rd. 1017, Bay Co., 6.383 miles to Wm. J. Meagher, Bay City, at $191,206; Rd. 10-2L, B., Iosco, 2.856 mi. to Hugh Campbell & Son, Bay City, at $92,300; Rd. 1023, Presque Isle Co. 4.295 mi. to Jno. Decker, Rogers, at $51,214; Rd. 10-24B, Presque Isle Co. 5.05 mi. to G. A. Leszczynski, Harbor Beach, $79,933; Rd. 13-5, Allegan Co., 3.354 miles to O. M. Whitlow, Muskegon, at $122,347; Rd. 13-7 Allegan Co., 5.734 miles to Eitel & Ayres, Co. Haven, at $207,189; Rd. 39-6, Eaton Co., 0.726 miles to Ann Arbor Asph. Constr. Co., Ann Arbor, at $31,683; Rd. 59-3, Macomb Co., .706 mi. to W. B. Hutchinson, Mt. Clemens, at $26,774; Rd. 68-1, A2, Ontonagon Co., 0.383 miles to W. E. Ule and H. N. Blackburn, Ontonagon at $16,101; Rd. 81-3, Bay Co., 5.97 miles, to Wm. J. Meagher, Bay City, at $227,016; Rd. 19-2-A, Sanilac Co., 5.526 miles, to V. F. Wilcox, Cargo, at $69,845; Rd. 34-1, Lenaweo Co., 8.533 mi., to Chicago Heights Coal Co., Chicago Heights, Ill., at $298,647.

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Md., Baltimore—P. Flanigan & Sons, Hartford Rd. & B. & O. R. R., award. contract for paving Liberty Heights Ave., old city limits to Hamilton Ave., asphalt; 50 ft. wide; $100,000. American Paving & Contracting Co., Montebello, award. contract for paving Charles St., betw. Lombard and Saratoga Sts., in addition to other streets, at $189,702.

Mo., Kansas City—G. G. Rodebush, awarded contract for paving Metropolitan Ave.—12th to 26th Sts., and Rubey Ave.—12th to 22nd Sts, with 4-in. brick block. City's estimate $173,000; contractor's price $4,000 less than est.

Mont., Helena—F. J. McHugh, 1632 4th Ave., West, Seattle, Wash., awarded contract for surfacing certain streets here with conc., at $349,453. Contr. involves laying 77,000 sq. yds. 7-in. conc., in addition to armored concrete curbs.

Neb., Nebraska City—Following paving contracts let by Co. Commrs. Douglas County: 5½ miles brk. surfacing Lincoln Hwy., in vicinity of Waterloo, to Hugh Murphy Constr. Co., 5 1/3 miles on the D-L-D Rd., near Millard, to Jas. J. Parks Co., and 4 mi. on Washington Hwy. bet. city and Washington County line to Allied Contractors, Inc. Prices run from $4.39 to $4.81 per yd. Total cost of contracts $673,711.

N. J., Trenton—Bd. Freeholders, Mercer Co., let contr. for paving 4 miles Brunswick Pike—Clarksville to Millstone River—involving 5,141 cu. yds. excav., 10,150 sq. yds. conc. and 43,700 sq. yds. asph. to J. J. Barrett, 147 Lafayette Ave., at $264,882.

N. Y., Brooklyn—C. J. Beckwith, Inc., 301 W. 108th St., N. Y. C., award. contract for impvt. of main rdway of Ocean Parkway—Park Circle at Prospect Pk. and Speedway near Ave. J.—at $203,-250.

N. C., Burlington—Hedrick Constr. Co., awarded contract for conc. and sheet asph. paving, at $275,-000.

N. C., Hillsboro—Elliott-Sholes Co., Durham, awarded contract for 4.1 miles conc. rd., 18 ft. wide, at $168,000.

O., Columbus—B. F. Patterson, awarded contract for paving Main St.—Allen Ave. to Alum Creek—at $189,200.

O., Columbus—State Hwy. Dept. let contracts for grading, draining and paving 3.372 miles Sec. H, Findlay-Kenton Rd., Hancock Co., asph. conc. on conc. base, to D. Ollier, Findlay, at $130,087; grading and paving 4.667 miles Sec. P, Oberlin-Norwalk Rd. brk. and 2.58 miles Sec. L, Norwalk-Plymouth Rd., conc., both Huron Co. to Hill & Hill, Elyria, at $193,020 and $52,232, respectively.

Pa., Erie—F. W. Knickenberg, Buffalo, awarded contr. for paving section of Concord Rd., at $102,-278.

Pa., Harrisburg—State Hwy. Dept. let contracts to following for road work: W. S. Morrison, New Brighton, Pa. for bldg. 4,607 ft. one-course rein. conc. roadway, Center Twp., Beaver Co. at $83,-932; Proj. located on St. Route 76 which connects Pittsburgh and Beaver; J. C. Devine Co., Alliance, O., for constr. of 18,619 ft. roadway on State Route 82, which connects Mercer and Deadville, at $264,-591; G. A. Flinck, Harrisvurg, for bldg. rein. conc. brdg. on Route 87, Northeast Twp., Erie Co., at $119,519; Lord Constr. Co., Hastings, Pa., awarded contr. for impvt. of section Route 62—hwy. leading from Ebensburg to Clearfield—at $162,299. Proj. calls for 10,822 ft. one-course rein. conc. roadway, 16 ft. wide; McInerney & McNeal, Easton, Pa., award. contr. for 5,875 ft. one-course rein. conc. rdway in Portland Boro., Northampton Co., at $59,851; Jones Constr. Co., Salem, O., contr. for 16,137 ft. one-course rein. conc. rd. Washington Co., Somerset and Nottingham Twps., at $198,299; Christiania & Kumer, Shamokin, awarded contr. for 26,200 ft. in Upper Augusta, Shamokin and Rockefeller Twps., Northumberland Co., at $204,-132; Malloy & Fitzpatrick, Long Island C., N. Y., awarded contr. for 15,955 ft. in Middletown and Falls Twps., Nucks Co., Route 261, at $211,396; T. L. Evans & Sons, Danville, contr. for 19,487 ft. in Columbia and Montour Cos., at $28,036; Chas. H. Fry Constr. Co., Erie, 9,924 ft. Springfield Boro., at $108,715; Souder Constr. Co., Lancaster, 11,459 ft. in Gettysburg and Cumberland Twps., Adams Co., at $174,090.

Tex., Galveston—J. C. Kelso, awarded contract for paving causeway, at $125,857. Pavement will consist of 7-in. conc. base, sand cushion 3-in. fiber brick and an asph. filler.

Tex., Paris—Smith Bros. & Healy Constr. Co., Dallas, awarded contr. for constr. of 13.85 miles of conc. rd., including grading and culvts. on hwy. 5 and 19, at $437,401.

Va., Williamsburg—J. A. Addenbrook's Sons, Norfolk, awarded contract for paving roadways; conc. and curbing—2 miles, at $170,000.

Wis., Madison—State Hwy. Comn., let contracts for grading and surfacing Monroe-Argyle Rd. (County Farm), Green Co. to J. F. Icke, 255 Washington Bldg., at $36,641; Monroe-Monticello Rd. F. A. P. 80, Green Co. to Miner Co. Richland Center, at $108,679.

Wis., Waukesha—Jacobs & Winding, Wauwatosa, awarded contr. for constructing 4.5 mi. Hwy. 19, at $120,867.

Wis., Waukesha—Frank Banazak, 1335 Fourth Ave., Milwaukee, awarded contract for Janesville-Plank Rd., F. A. P. 14, at total of $134,595.

Wis., Wausau—Brogan, Schaefer & Minton, Green Bay, awarded contr. for Marshfield-Ashland Rd., F. A. P. 224, at $151,418.

SEWERAGE AND SEWAGE TREATMENT

Cal., Alameda—Tibbitts-Pacific Co., awarded contract for north side sewer, at $142,600.

Cal., Biggs—H. Gould, Sacramento, awarded contract for sewer system, at $44,895.

Cal., E. San Diego—Jno. P. Kennedy, 405 W. Adams St., Los Angeles, awarded contract for constr. of cem. pipe trunk line and outfall sewer for E. San Diego, at $75,563.84.

Ia., Cedar Heights—Sieg Constr. Co., 712 Blackhawk Bldg., Waterloo, awarded contract for bldg. san. sewerage system in various streets, at about $58,000.

Ia., Pleasantville—G. G. Herrick, Des Moines, awarded contr. for constructing sewer system, at $42,741.

Mass., Boston—A. Barrufaldi, Somerville, award. contr. for constr. of sewers, etc., in Rosindale Branch of Stony Brook in Fifth Ave., and private land, involving 955 ft. 10 ft. 9-in. and 163 ft. 6 ft. 3-in. rein. conc. sewers, at $84,062.

Md., Hagerstown—D. H. Whitmer, Phila., Pa., awarded contract to constr. Unit No. 4, sewer system, at $200,000.

Mich., Detroit—City let contract for bldg. (1) Newport Ave., Sec. 2, (2) Newport Ave., Sec. 3, Newport Ave. (Sec. 4), Seven Mile Rd. Sewer, Lateral Sewer 3356, Lat. 3397, Lat. 3421, Lat. 3423, Lat. 3424, Lat. 3358, Lat. 3409, Lat. 3410, 3417, 3419, 3428, 3426, involving Contracts Nos. 1 to 18, inclusive to: R. D. Baker, 485 Elmhurst Ave., at $84,384; W. Blanck & Co., 827 Ford Bldg., $85,284, (2) (3) $79,455; (5) $13,994; (6) $21,030; (7) $7,468; (8) $2,055; (9) $18,423; (10) $9,595; J. F. Casey Co., Water Works Park, (4) $433,156; C. R. Lenane, 909 Union Tr. Bldg., (11) $44,540; (12) $7,422; Detroit Draing. Constr. Co., Penobscot Bldg., (13) $2,890; Detroit Contg. Co., 827 Ford Bldg., (14) $4,856; (15) $5,043; (16) $3,374; (17) $20,432; J. Zucola (18) $4,950.

Mo., St. Louis—Frazier-Davis Constr. Co., Arcade Bldg., awarded contract to construct 2,975 ft. 12 to 15, and 39 to 51-in. vitr. clay and brk. or segm. blk. pipe sewer in Harlem-Goodfellow Sewer Dist., at $37,305; Fruin & Colnon Constr. Co., Merchants-Laclede Bldg., to construct 9,085 ft. 39 to 48 and 6 to 30-in. brk. or segm. blk. pipe sewer in Glaise Crk. Sewer Dist. No. 17, at $62,280; Frazier-Davis Construction Co., Arcade Bldg., contr. to constr. 5,930 ft. 12 to 36-in. vitr. pipe sewer in Clifton Heights Sewer Dist. No. 3, at $23,000.

N. J., Roselle—Jos. Miele & Co. will be awarded contr. for constr. of joint Roselle-Linden sewer, at $61,848.

N. J. Teaneck—G. De Napoli, 167 Main St., Hackensack, awarded contr. by Twp. Comn. for bldg. sewers in various sections at abt. $79,000.

N. Y., New York City—Bronx Borough awarded contracts for sewers as follows: Neill Ave., to J. E. Gaffey, 438 E. 91st St., $112,659; Pierce Ave., etc., to F. Demicco, Clarence Ave. and 134th St., $29,264; Middletown Rd., to J. L. Sigretto, $181,982.

N. Y., W. New Brighton, S. I.—Yonkers Contg. Co., 621 So. Bway., Yonkers, awarded contract for bldg. sewer and draing. system for 21 pavilion bldgs. in Sea View Hosp., on Manor Rd., here, at $60,990.

O., Akron—E. & W. McShaffrey, Rhoades Ave., awarded contract for bldg. So. Arlington Trunk sewer, at abt. $170,000.

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Kirschbraun, Lester.

Cement Testing Machinery.
Tinius Olsen Testing Mach. Co.

Chimneys, Concrete.
Truscon Steel Co.

Chimneys, Steel.
Lewis-Hall Iron Works.
Littleford Brothers.

Chloride of Lime.
Pennsylvania Salt Mfg. Co.

Chutes, Concrete.
Heltzel Steel Form & Iron Co.
Littleford Brothers.

Concrete Mixers.
Austin Machinery Corporation.
Koehring Machine Co.
Smith Co., T. L. The

Concrete, Reinforcement.
American Steel & Wire Co.
Truscon Steel Co.

Conduits.
Cannelton Sewer Pipe Co.
Truscon Steel Co.

Conduit Rods.
Stewart, W. H.

Conduits, Wood, Creosoted.
Republic Creosoting Co.

Consulting Engineers.
Alvord, John W.
Artingstall, Wm.
Brossmann, Chas.
Burd & Giffels.
City Wastes Disposal Co.
Dow & Smith.
Fargo Engineering Co.
Flood, Walter H., & Co.
Samuel A. Greeley.
Hill & Ferguson
Howard, J. W.
Hunt & Co., Robert W.
Jones, Sam L.
Kirchoffer, W. G.
Kirschbraun, Lester.
Potter, Alexander.
Shields, W. S.
Van Trump, Isaac.
Wells, James P.

Contractors.
City Wastes Disposal Co.
Sullivan, Long & Hagerty.
Warren Bros. Co.

Contractors' Tools and Machinery.
Austin Machinery Corporation.
Austin-Western Co., Ltd., The
Barber Asphalt Paving Co.
Good Roads Machinery Co., Inc.
Koehring Machine Co.
Littleford Bros.
Smith Co., T. L. The

Contractors' Wagons.
Austin Machinery Corporation.
Austin-Western Co., Ltd., The

Conveying Machinery.
Mead-Morrison Mfg. Co.
Pawling & Harnischfeger.
Portable Machinery Co., Inc.
Webster Mfg. Co.

Cranes and Hoists.
Austin Machinery Corporation.
Heltzel Steel Form & Iron Co.
Pawling and Harnischfeger.

Creosote.
The Barrett Co.
Republic Creosoting Co.

Creosoted Wood Block.
(Factory Floors, Bridge Floors)
Republic Creosoting Co.

Crushers, Rock and Ore.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

Crushed Stone.
Cleveland Stone Co., The

Culvert Molds.
Austin-Western Co., Ltd., The

Culvert Pipe, Cast Iron.
American Cast Iron Pipe Co.

Culvert Pipe, Vitrified.
Cannelton Pipe Co.
Dee Clay Mfg. Co., Wm. E.

Culverts.
Newport Culvert Co.
Truscon Steel Co.

Curb and Gutter Forms.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Curb Bar.
Truscon Steel Co.

Curbing, Sandstone.
Cleveland Stone Co., The

Direct Oxidation Process.
Direct Oxidation Process Corp.

Drag-Line Excavators.
Austin Machinery Corporation.

Drag Scrapers.
Austin-Western Road Machinery Co.

Drain Tile.
Dee Clay Mfg. Co., W. E.

Dryers.
Cummer & Son Co., The F. D.

Dump Cars.
Austin-Western Road Machinery Co.

Dump Wagons.
Austin-Western Road Machinery Co.

Ore., Portland—City let contract for building sewers in Thurman and 29th Sts. and private right-of-way, involving 1,743 ft. 6-24 in. vitr. tile pipe, 6,303 ft. 36-60 rein. conc. pipe (monolithic), 200 ft. 8-in. drain pipe, 3,000 lin. ft. piling and 60 lbs. reinforcing steel, to J. F. Shea, 7 North 2nd St., at $169,809.

S. D., Elk Point—O. N. Gjellafald, Forest City, Ia., awarded contract for bldg. sewerage system, involving 23,800 ft. sewer tile, pumping plant equipt and 5,800 ft. outlet title pipe, at $52,100.

Tenn., Knoxville—J. Gordon Powers, awarded contract to construct 8,000 ft. trunk line sewer from 5th Ave., bridge to Oakwood, at $50,000.

Wyo., Cheyenne—C. R. Jumau, Casper, Wyo., awarded contract for bldg. 10½ miles 12 to 84-in. san. sewer in various streets, at $418,738.

WATER SUPPLY AND PURIFICATION.

Cal., Turlock—Pittsburg Valve & Foundry Constr. Co. awarded contr. for furnishing gate valves for Don Pedro dam, at $179,500.

Ida., Blackfoot—Wheelwright Constr. Co., Main Street, Ogden, Utah, awarded contract for bldg. small pumping station, elevated tank and tower, 54,000 ft. 4-in. steel and 650 tons 6 to 16-in. cast iron pipe, at $188,230.

Ill., Winnetka—Hoeffer & Co., 133 W. Washington St., Chicago, Ill., and American Water Softener Co., Philadelphia, Pa., awarded contract for constructing 3,000,000-gal. filtr. plant, at total cost of $125,000.

Ia., Council Bluffs—E. A. Wickham & Co., 19 Scott St., awarded contr. for bldg. 10,000,000-gal. rein. conc. reservoir and laying 15 miles 6-in. conc. water mains, at $149,250.

Mich., Detroit—Gillespie Contg. Co., 50 Church St., New York City, awarded contract for bldg. pipe line in various streets here, at total cost of $807,300.

Minn., So. St. Paul—Fegels Constr. Co., 706 First Ave., N. Minneapolis, awarded contract for bldg. 125,000-gal. rein. conc. tower and tank, at $23,310; J. W. Hildred Co., 1019 Commercial Bldg., St. Paul, awarded contract for bldg. 1 deep well pump, centrif. electric motor driven, 1,000-gal. capy. against min-max head of 300 to 325 ft. and 1 booster centrif. pump on reservoir flr., double suction, 250 gal. per min. capy. against 85 to 120 ft. min.-max. head, at $14,306, including pump house and fixtures.

N. C., Greensboro—Proximity Mfg. Co., Bernard C. White, Pres., let contract to Tucker & Laxton, Realty Bldg., Charlotte, N. C., to construct pumping station, filter plant and pipe lines to replace deep well system; install motor driven pump, at $150,000 to $200,000.

Ore., Portland—Hauser Constr. Co. awarded contract for work at head works of city's water system, at Bull Run River, at $220,000.

R. I., Providence—Winston & Co., Inc., 240 Fair St., Kingston, N. Y., awarded contract for constructing main earth dam and dike, 4,500 ft. long and 110 ft. high at Scituate Reservoir, Pawtuxet River, at $3,449,925.

Tenn., Nashville—G. B. Howard & Co. awarded contract for construct. rein. conc. grit chamber, pumping station, super-struct. impvts., foundation for pumping engines, etc., at $217,300.

Prospective Work

ROADS AND STREETS.

Ark., Blytheville—Plans for completion of paving of entire city are now well under way with engineers working daily in surveying and preparing specfs. Portion of City paved some months ago but work suspended during Winter. New contracts let for prelim. work to C. E. Smith Engr. Co.

Cal., Newport Beach—City Trustees have instructed City Engr. Paul E. Kressly, I. W. Hellman Bldg., Los Angeles, to prepare plans and specfs. for paving practically all streets in Balboa and E. Newport; also Central Ave., from bridge in Newport to end of sand pit. Est. cost abt. $350,000. Probably 7-in. conc. on Central and 5-in. on side streets.

Cal., Oakland—Plans for impvt. of 1st street—eastern line of Adeline to Fallon St.—submitted to Council by Geo. Mattis, City Engr. Southern Pacific Co. will bear $772,722 of the expense, City, $899,135 and property owners $126,413.

Cal., Palo Alto—City's street paving program, to be undertaken within a few weeks, will include work on 11 streets, involving constr. of 926,514 sq. ft. paving, 13,872 linr. ft. curbing and 9,368 sq. ft. walks. Est. cost $194,611. City Engr. J. F. Byxbee, Jr.

Ind., Indianapolis—Bd. Pub. Wks. adopted resolutions for paving North St., Mansfield Ave., Ogden St., Hiatte St. and Kealing Ave. Resolution also adopted for opening and widening 1st alley west of Sunset Ave.; Board has also decided to eliminate all jogs in E. New York St., which will add abt. $10,000 to cost of proposed New York Street proj., not including paving. Board has confirmed resolution for E. 10th St. sewer and prelim. orders for impvt. (permanent) of Garfield Ave., for resurfacing Ft. Wayne Ave. and New York St., permanent impvt. of 47th St. and 1st alley east of Ritter Ave.

Ind., Indianapolis—Bd. Pub. Wks. has decided to construct paving on Madison Ave., Washington St. and Indiana Ave. Plans also ordered prepared by City Engr's. Dept. for resurfacing parts of 5 business streets.

Kans., Emporia—7 blocks paving will be laid here this Summer, in addition to abt. $100,000 worth of sewer constr., Disposal plants will be constructed on Neosho and Cottonwood rivers.

Kans., Wichita—County Commrs. making plans on constr. of Cannon Ball Rd.—Wichita to Kingman County line—24½ miles. Gov. Henry J. Allen has promised Comm. of Wichita men, interested in the paving, that he will do all in his power to obtain as much federal aid and state aid as possible toward carrying out the project.

Minn., Minneapolis—Plans prepared for paving 11.8 miles on Lyndale Ave. Est. cost $400,000.

Miss., Jackson—Hinds County has sold $600,000 bonds for constr. of Clinton-Jackson Rd. W. S. Wells, Clk. of Supvrs.

Mo., St. Joseph—Buchanan County having plans prepared for paving 4 miles Garrettsburg Rd. 18 ft. wide, bitum., at cost of $113,000; 8½ miles East Rd., 18 ft. wide, at $227,000. J. D. Mohler, Court House, Engr.

Neb., Norfolk—$200,000 work of additional paving will be constructed here this year. Bids for new jobs of asph. conc. will be opened in near future.

N. J., Trenton—City Council passed Ord. to grade and curb 15 streets.

N. C., Greenville—Pitt County plans to construct 10 miles hard surf. roads betw. Greenville and Farmville; also Greenville and Lenoir Co. line, 18 ft. wide. Abt. $300,000.

N. C., Raleigh—State Hwy. Comn.—Frank Page, Chrmn.—apportioned $10,000,000 of $50,000,000 bond issue among 9 Dists., to be expended this year on road construction. Plans ultimate constr. of 6,000 miles of roads in these districts.

Okla., Bristow—First step preparatory to paving more than 50 blocks city's streets, taken by Council. Program will cover nearly all the principal streets, including 9 blocks on Main St. This will give city approx. 8 miles paved streets. Program, which includes sewer and water impvts., will call for expendt. of approx. $500,000.

Pa., Philadelphia—City announces plans for the use of $5,000,000 this Summer for repaving nearly 70 miles of city streets.

S. C., St. Matthews—City plans to pave various streets; Asph. conc. Est. cost abt. $325,000. J. R. Pennell, Columbia, Engr.

S. D., Sioux Falls—Will soon call for bids for paving 47 blocks. Includes First Ave. Duluth Ave., 26th St., 13th St., and curbing 26th St. Walter Leyse, City Clk.

Tenn., Jacksboro—Campbell Co. will construct Dixie Hwy.—Anderson County line near Coal Crk., to Jellico, 42 miles; Ky. Rock Asph., 16 ft. wide. Bids about July 2nd.

Tenn., Kerrville—Kerr Co. having plans prepared for grading, paving and draining 7.45 mi. St. Hwy. 41—Ingram to Kerrville. Est. cost abt. $30,800. W. E. Simpson Co., 506 Hicks Bldg., San Antonio, Engrs.; plans also being prepared for grading, paving, draining, etc., 13.3 miles St. Hwy. 27—Kimble Co. line to Mountain Home. Abt. $76,618. W. E. Simpson Co., Hicks Bldg., San Antonio, Engrs.

Tex., Rock Springs—Edwards County will con-

BUYERS' GUIDE

Dust Laying Compound.
The Barrett Co.
Standard Oil Co. (Indiana)
The Texas Co.

Edge Protector.
Truscon Steel Co.

Electrical Wires & Cables.
American Steel & Wire Co.

Elevating Graders.
Austin-Western Road Machinery Co.

Elevators.
C. H. & E. Mfg. Co.

Engineering Instruments.
Kolesch & Co.
Lufkin Rule Co., The

Engines.
C. H. & E Mfg. Co.
Midwest Engine Co.

Excavating Machinery.
F. C. Austin Machinery Co.
Pawling and Harnischfeger.
Sauerman Bros.
Smith Co., T. L. The

Expansion Joint Compound.
The Barrett Co.
Pioneer Asphalt Co.
Truscon Steel Co.

Explosives.
E. I. du Pont de Nemours & Co

Fence, Iron.
Cincinnati Iron Fence Co.

Fillers (Paving Joint).
Barber Asphalt Paving Co.
The Barrett Co.
Pioneer Asphalt Co.
The Texas Co.

Fire Brick.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Flue Liners.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Forms, Sidewalks, Curb & Gutter
Heltzel Steel Form & Iron Co
Truscon Steel Co.

Forms, Road.
Heltzel Steel Form & Iron Co
Truscon Steel Co.

Forms (Sewers & Conduits).
Heltzel Steel Form & Iron Co.

Forms (Wall Bldg., Construction Etc.).
Heltzel Steel Form & Iron Co

Gas Pipe.
American Cast Iron Pipe Co.
U. S. Cast Iron Pipe & Fdy. Co

Graders.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

Granite Block.
Granite Paving Block Mfrs. Assn. of the U. S., Inc.

Gravel Screener and Loader.
Good Roads Machinery Co., Inc.
Jordan & Steele Mfg. Co., Inc.

Heaters (Rock and Sand).
Littleford Bros.

Heating Wagons (Oil and Tar).
Good Roads Machinery Co., Inc.
Littleford Bros.

Hoists (Concrete, Gasoline and Hand).
Pawling and Harnischfeger.

Hoists, Electric.
Mead-Morrison Mfg. Co.
Pawling and Harnischfeger.

Hoists, Steam.
C. H. & E. Mfg. Co.
Lewis-Hall Iron Works.
Mead-Morrison Mfg. Co.

Hot Mixers.
F. C. Austin Machinery Co.
Barber Asphalt Paving Co.

Hydrants.
The Flower Company.

Inlets (Sewer).
Dee Co., Wm. E.
Madison Foundry Co.

Insulating Material.
The Barrett Co.
Pioneer Asphalt Co.

Joint Fillers (Paving).
The Barrett Co.
The Texas Company.

Kettles (Portable).
Barber Asphalt Paving Co.
Cummer & Son Co., The F. D.
Good Roads Machinery Co., Inc.
Littleford Brothers.

Loaders.
Brown Portable Conveying Machine Co.

Manhole Covers.
Madison Foundry Co.
Dee Co., Wm. E.

Mastic.
Pioneer Asphalt Co.

Meter Boxes.
McNutt Meter Box Co.

Mixers, Asphalt.
Austin Machinery Corporation.
Barber Asphalt Paving Co.
Cummer & Sons Co., The F. D.

Mixers, Concrete.
Austin Machinery Corporation.
Koehring Machine Company.
T. L. Smith Co.

Mixers—Mortar.
C. H. & E. Mfg. Co.

Molds (Pipe & Culvert).
Heltzel Steel Form & Iron Co.

Motor Fire Apparatus.
Acme Motor Truck Co.
Diamond T Motor Car Co.
Duplex Truck Co.
Federal Motor Truck Co.
Garford Motor Truck Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Motor Trucks.
Acme Motor Truck Co.
Duplex Truck Co.
Diamond T Motor Car Co.
Federal Motor Truck Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Motor Truck Flushers, Sprinklers and Oilers.
Acme Motor Truck Co.
Austin Machinery Corporation.
Diamond T Motor Car Co.
Duplex Truck Co.
Federal Motor Truck Co.
Garford Motor Truck Co., The
The Gramm-Bernstein Motor Truck Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Municipal Castings.
Dee Co., Wm. E.
Madison Foundry.

Packing.
Pioneer Asphalt Co.

Paints (Asphalt).
Barber Asphalt Paving Co.
Barrett Co., The
Pioneer Asphalt Co.

Paving Blocks (Creosoted).
The Barrett Co.
Republic Creosoting Co.

Paving Brick.
Medal Paving Brick Co.
Metropolitan Paving Brick Co.
Murphysboro Paving Brick Co.
National Paving Brick Mfrs. Assn.
Springfield Paving Brick Co.

Paving Contractors.
Warren Bros Co.

Paving Joint Compound.
Barber Asphalt Paving Co.
The Barrett Co.
Pioneer Asphalt Co.
The Texas Company.

Paving Joint Filler.
Barber Asphalt Paving Co.
The Barrett Co.
Pioneer Asphalt Co.
The Texas Company.

Paving Machines.
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Warren Bros. Co.

Paving Plants (Asphalt).
Austin Machinery Corporation.
Barber Asphalt Paving Co.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Good Roads Machinery Co., Inc.
Smith Co., T. L. The
Warren Bros. Co.

Pipe Cutters.
W. W. Strickler & Bro.

Pipe Dip and Coatings.
The Barrett Co.
Pioneer Asphalt Co.
The Texas Co.

Pipe Manufacturers.
American Cast Iron Pipe Co.
U. S. Cast Iron Pipe & Fdy. Co.

Pitch Filler.
The Barrett Co.
Warren Bros. Co.

Plows (Rooter and Wing).
Austin-Western Road Cach. Co.

Portable Paving Plants.
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Good Roads Machinery Co., Inc.
Littleford Brothers.
Warren Bros. Co.

Portable Stone Bins.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

Pumps.
C. H. & E. Mfg. Co.
De Laval Steam Turbine Co.
Harris Air Pump Company.
Midwest Engine Co.
Smith Co., T. L., The

Reinforcing For Pavements.
American Steel and Wire Co.
Truscon Steel Co.

Road Building Material.
Barber Asphalt Paving Co.
Kentucky Rock Asphalt Co.
Sinclair Refining Company.
The Texas Co.

struct 50 miles gravel roads: $450,000 available. W. E. Simpson Co., Cons. Engrs., San Antonio.

Va., Norfolk—Paving program for 1921 for this City will cost $1,750,000. Council will make tour of streets included in program to see conditions of the thoroughfares.

Wis., Oshkosh—Winnebago Co. Commrs. adopted resolutions to construct 3 pieces concrete road as follows: Oshkosh-Winneconne Rd., 1½ miles; $45,000; Oshkosh-Omro Rd. east from Omro, $125,000; Algoma Street along Riverside cemetery, Oshkosh, 1 mile, $30,000. Also approp. $7,000 for completion of Menasha-Waverly Beach Rd. Jas. Binning, Oshkosh, Co. Hwy. Commr.

SEWERAGE AND SEWAGE TREATMENT.

Cal., Burbank—City has authorized bond issue of $140,000 bonds for installation of san. sewer system.

Cal., Culver City—Koebig & Koebig, Cons. Engrs. Title Ins. Bldg., Los Angeles, retained by City Trustees to prepare plans for sewer sys. and sewage disp. plant for City; main sewer lines and disp. plant.

Cal., Modesto—City Engr. Freitas submitted to Council plans for storm sewer in Virginia and other streets—abt. 7,920 ft. estimated to cost $30,000.

Cal., Pasadena—Resolution adopted by City Comn., to construct sewers in portions of Arroyo Blvd., San Rafael Ave., and 8 other streets in San Rafael Heights Annex, 8, 10, 12 and 14-in. vit. pipe will be laid. Resolution also adopted by City Council to constr. an 8-in. vit. pipe sewer in Las Lunas Sr., abt. 945 ft., 1 manhole, 2 flush tanks and 32 Y branches.

Cal., Visalia—Plans and specfs. for extensions to city sewer system under the $112,000 bond issue, approved by City Trustees.

Ill., Chenoa—City will receive bids abt. Aug. 8 for 11½ miles filled ditch work, including rein. conc. tile, 10 to 36-in. Abt. $100,000. Folsom and Taylor, Bloomington, Engrs.

Ill., Geneseo—It is proposed to construct complete sewerage system at Geneseo at cost of abt. $150,000.

Me., Orono—Town having plans prepared for 8 miles sewereage system. Weston & Sampson, 14 Beacon St., Boston, Engrs.

Mich., Stambaugh—Plans being prepared for sewerage system. Abt. $70,000. Greeley, Pearse & Hansen, 39 W. Adams St., Chicago, Engrs.

Minn., New Prague—Plans being prepared for sewerage system and sewage disp. plant. $98,000 voted for project. J. F. Bruzek, Clk.; J. W. Shaffer & Co., 917 N. Y. Life Bldg., Minneapolis, Engrs.

Minn., Twin Valley—Prelim. surveys being made for bldg. sewerage and water systems. P. A. Presting, Vil. Clk., $60,000.

Mo., Eldon—Prelim. survey for sewer system for Eldon completed by E. T. Archer & Co., municipal engineers of Kansas City. Entire cost est. at $71,083, including disposal plant and main sewer.

Mo., Independence—Sewer system in City will be improved at approx. cost of $130,000.

Mo., Kansas City—Bd. Pub. Wks. has retained Pearse, Greeley & Hansen, Cons. Engrs., Chicago, Ill., to report upon intercepting sewers and sewage treat. for Blue River sewerage project. Project includes abt. 75 per cent Kansas City. Est. cost abt. $2,750,000.

Mo., Kirksville—Plans constr. of 12-in. pipe line from reservoir to City; 8-in. distributing system and 100,000-gal. standpipe. J. Dunbar, Engr.

N. J., Newark—U. S. Supreme Court has authorized this state to proceed with bldg. of outlet of Passaic valley trunk sewer in New York Bay. Sewerage Comn. will at once obtain approval of all participating municipalities to execution of 3rd supplemental contr. calling for appropriation of $2,700,000. Mr. J. Ralph Van Duyne, Chf. Engr.

N. Y., No. Tonawanda—Plans prepared by engineers in connection with comprehensive sewer survey call for expendt. of $750,000. Impvts. will include sewage disposal plant on Tonawanda Island and erection of 14 lift stations.

N. C., Mt. Airy—City contemplates constr. of sewer system at cost of approx. $75,000. A. V. West, Mayor.

O., Conneaut—Ord. passed by City Council authorizing Direct. Pub. Serv. to secure engineer to make survey of City's sewage disp. needs.

Okla., Bristow—City Engr. instructed to make survey preparatory to preparing ests. for several miles of sewer extension. Another trunk line sewer, more than 2 miles long will be laid, according to Mayor Slocum. Impvt. program as announced by the Mayor and passed upon by City Coucil, will necessitate expendt. of approx. half a million dollars. City will also take steps to improve water supply; will dig a number of new wells.

Okla., Tulsa—$600,000 bonds voted here for sewer extension. T. D. Evans, Mayor.

Tex., Farmersville—$100,000 sewer and water bonds voted here.

Tex., Hamlin—$65,000 sewer extension bonds voted.

WATER SUPPLY AND PURIFICATION.

Cal., Chico—System of meters will be installed by Chico Water Supply System. A. G. Simpson, Pres. Water Co.

Ill., Galesburg—Property owners in favor of $100,000 bond issue for extension of water mains. Election to vote on bonds in near future.

Ia., Mason City—Engr. Louis P. Wolff, 1000 Guardian Life Bldg., St. Paul, making plans for 5,000,000-gal. conc. reservoir and alterations and additions to pumping station. Ready for bids in near future. Addition includes pumping equipt., additional boilers and misc. piping. J. H. McEwen, City Clk.

Mo., Brookfield—$140,000 bonds voted for water works impvts. E. E. Harper, 3831 Park Ave., Kans. City, Mo., Engr.

Mo., Jefferson City—State Pub. Serv. Comn. has ordered Independence Water Co. to present plans by July 15 for supplying city with adequate water service.

Mo., New Haven—It has been decided to improve and extend water and electric light system; install 75 G. P. M. motor driven turbine pump for 260 ft. total head; altern. on double-acting dep well pumping unit for 50 G. P. M.

N. J., Florence—Borough plans constr. of water works plant at approx. cost of $100,000. C. B. Green, Clk.

N. Y., Albany—Council passed Jones Ord. providing for electrification of pumps at filter plant and impvt. of water works system, appropriating $200,000 for the work.

N. Y., Buffalo—City having plans prepared for 12 to 20-in. cast iron high pressure fire line from pump'g. sta. to Pearl St. Abt. $400,000. Cundall, Powell & Mosher, 80 West Genesee St., Engrs.

O., Columbus—City has authorized issuance of $3,000,000 bonds to improve and extend water works system, including constr. of the Shaughnessy Dam on Scioto River abt. 12 miles north of here; also laying 42-in. main from filtr. plant and pumping sta. across to north end, thus reinforcing 32-in. main which runs along Denison Av. Plans for filtr. beds are abt. completed and bids will soon be received. C. B. Hoover, Engr. J. H. Gregory, 3925 Centerbury Rd., Baltimore, Cons. Engr.

Ore., Warrenton—City will increase water supply. Proj. contemplates constr. of new pipe line 20 miles long, at cost of $500,000.

S. D., Beresford—City will sink new well at water works plant and will also purchase engine for municipal electric plant. Pumping will be done by electricity. Council authorized $70,000 bond issue.

S. D., Watertown—Plans for impvt. of water works plant at Lake Kampeska by installation of new pumps, electrical power and investigation of, and possible equipt., will filtr. system, undertaken at meeting of City Council. City Engr. and Water Supt., authorized to investigate and make recommendations on filtration system, in new pumping apparatus and on an elec. line to pumping station from municipal light and power plant.

S. D., Yankton—Cons. Engr. Geo. T. Prince, 532 Bee Bldg., Omaha, Neb., preparing plans for installing municipal intake and settling and purifying tank for pure soft water supply system for city. Water from Mo. river channel. Jno. W. Summers, City Clk.

W. Va., St. Albans—City will soon advertise for bids for installing filtr. plant, 1,000,000-gal. daily capy. on Coal River, including sedimentation basin and 2 sand filters for St. Albans Water & Light Co. Est. cost abt. $75,000.

Wyo., Newcastle—Plans being prepared for 4½ miles 6 and 8-inch vitr. clay gravity flow line and 2 conc. intakes, at approx. cost $30,000. Bond Engrg. Co., Engrs.

BUYERS' GUIDE

Road Binder.
Barber Asphalt Paving Co.
The Barrett Co.
Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
The Texas Co.
Uvalde Asphalt Paving Co.
Warren Bros. Co.

Road Forms.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Road Graders.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Road Machinery.
Austin Machinery Corporation.
Austin-Western Road Machinery Co., The
Barber Asphalt Paving Co.
Cummer & Son Co., The F. D.
Good Roads Machinery Co., Inc.
Littleford Brothers.
Midwest Engine Co.
Warren Bros. Co.

Road Planer.
Austin-Western Road Machinery Co., The

Road Oil and Preservatives.
Barber Asphalt Paving Co.
The Barrett Co.
Standard Oil Co. (Indiana)
The Texas Co.

Road Rollers.
Austin-Western Road Machinery Co., The
Barber Asphalt Paving Co.
Good Roads Machinery Co., Inc.

Rock Crushers.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Roofing Material.
Barber Asphalt Paving Co.
The Barrett Co.
Pioneer Asphalt Co.
The Texas Co.
Warren Bros. Co.

Sand Dryers.
Cummer & Son Co., The F. D.
Littleford Brothers.

Saw Rigs.
C. H. & E. Mfg. Co.

Sandstone.
Cleveland Stone Co.

Scarifiers.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Scrapers, Drag Line.
Pawling and Harnishchfeger.
Sauerman Bros.

Scrapers, Graders, Plows, Etc.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Scrapers, Power.
Sauerman Bros.

Sewage Treatment.
Direct Oxidation Process Corp.

Sewer Braces.
Kalamazoo Fdry. & Mach. Co.
Dee Co., Wm. E.
Madison Foundry Co.

Sewer Cleaning Machinery.
Stewart, W. H.

Sewer Forms.
Heltzel Steel Form & Iron Co.

Sewer Pipe.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Sewer Rods.
Stewart, W. H.

Sidewalks (Stone).
Cleveland Stone Co.

Sluice Gates.
Coldwell-Wilcox Co.

Snow Removal Machinery.
Austin Machinery Corporation.
Good Roads Machinery Co., Inc.

Special Castings.
The Flower Company.
U. S. Cast Iron Pipe & Fdy. Co.

Sprinklers.
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Austin-Western Road Machinery Co., The

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Stone Elevators.
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Littleford Brothers.

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Cleveland Stone Co.

Street Flushers (Horse Drawn).
Austin-Western Road Machinery Co.

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The Texas Co.

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Littleford Brothers.

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The Barrett Co.

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Testing Chemists.
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Austin-Western Road Mach. Co.

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Kalamazoo Fdy. & Machine Co.
Pawling and Harnischfeger

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Barber Asphalt Paving Co.

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De Laval Steam Turbine Co.

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The Flower Company.

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Cannelton Sewer Pipe Co.

Warranite.
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National Water Main Cleaning Co.

Water Pipe.
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